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Sampling and Analysis Plan for Ground-Water Monitoring of Wells near the Metropolitan Utilities District's Platte River West Well Field near Wann, Nebraska: Part I, Field Sampling Plan and Part II, Quality Assurance Project Plan

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Sampling and Analysis Plan for Ground-Water Monitoring of Wells near the Metropolitan Utilities District's Platte River West Well Field near Wann, Nebraska: Part I, Field Sampling Plan and Part II, Quality Assurance Project Plan

By V.L. McGuire, J.A. Godberson, and R.C. Wilson

Prepared in cooperation with the
Metropolitan Utilities District, Omaha, Nebraska

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Conversion Factors and Datum

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,047	square meter (m^2)
	Volume	
ounce, fluid (fl. oz)	29.57353	milliliter (mL)
quart (qt)	0.9464	liter (L)
gallon (gal)	3.785	liter (L)
gallon (gal)	0.003785	cubic meter (m^3)
milliliter (mL)	0.0338	ounce, fluid (oz)
liter (L)	33.82	ounce, fluid (oz)
	Flow rate	
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
	Mass	
ounce, avoirdupois (oz)	28.35	gram (g)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8 \times °C) + 32$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C = (°F - 32) / 1.8$$

Vertical coordinate information, unless otherwise indicated, is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29). Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C). Concentrations of chemical constituents in water are given in micrograms per liter (µg/L).

Sampling and Analysis Plan for Ground-Water Monitoring of Wells near the Metropolitan Utilities District's Platte River West Well Field near Wann, Nebraska: Part I, Field Sampling Plan and Part II, Quality Assurance Project Plan

By V.L. McGuire, J.A. Godberson, and R.C. Wilson

Introduction

This report describes semiannual ground-water sampling and chemical analysis of observation wells near the Metropolitan Utilities District (MUD) Platte River West Well Field for at least 2 years for possible contaminants from the former Nebraska Ordinance Plant (NOP) site near Mead, Nebraska. To meet the needs and requirements in providing adequate data and background information, a Sampling and Analysis Plan (SAP) was prepared by the U.S. Geological Survey (USGS), in cooperation with MUD. The SAP consists of two parts: (1) Field Sampling Plan (FSP) and (2) Quality Assurance Project Plan (QAPP). Acronyms used in this report, including acronyms used in references, are listed in Appendix A.

The FSP is the first part of the SAP and describes ground-water observation well locations, field measurement procedures and criteria, sampling methods, sample container requirements, preservation, and decontamination procedures. The second part of the SAP is the QAPP, which describes the chemical-data quality objectives (DQOs), analytical procedures and measurements, including laboratory quality-control (QC) protocols necessary to achieve DQOs, and data-assessment procedures for the evaluation and identification of any data limitations. The chemical analysis will be done in compliance with guidance by the American National Standards Institute (ANSI) and American Society for Quality (ASQC) (ANSI/ASQC, 1995), U.S. Environmental Protection Agency (USEPA) (USEPA, 2001a), and U.S. Army Corps of Engineers (USACE) (USACE, 1997, 2001). Water samples, which will be analyzed for 61 volatile organic compounds (VOCs) analytes, will be sent to the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado. The analyses for explosives and seven VOC compounds will be done by the Severn Trent Laboratory (STL) in Denver, Colorado.

The SAP was reviewed and approved by the MUD, USGS Nebraska Water Science Center (NWSC), and USACE with respect to technical accuracy of sampling locations and technical adequacy of sampling, analysis, and reporting procedures. The part of the QAPP that relates to NWQL was reviewed and approved by NWQL to indicate the document accurately reflects login, analysis, and reporting procedures for the designated NWQL laboratory methods. The part of the QAPP that relates to STL was reviewed and approved by STL to indicate the document accurately reflects login, analysis, and reporting procedures for the designated STL laboratory methods. The MUD, NWQL, NWSC, STL, and USACE signatures indicating approval are filed with project documents at NWSC.

The SAP is published as a web-only USGS Open-File Report. When the report became available on the Web, a notice with the Web address was sent to personnel in Lower Platte North Natural Resources District (LPNNRD), MUD, Nebraska Department of Environmental Quality, NWQL, STL, USEPA, USGS, and USACE. The distribution list with name, address, and phone number of each person who received this notice is filed with project documents at NWSC.

Part I—Field Sampling Plan

FSP describes ground-water monitoring activities at six observation wells that are west and south of MUD Platte River West Well Field near Wann, Nebraska (fig. FSP-1).

FSP 1.0 Project Background

Ground water in western Douglas County and eastern Saunders County, Nebraska, currently (2005) is being developed to provide additional drinking-water supply for MUD. MUD serves the Omaha metropolitan area as a provider of both drinking water and natural gas. To supplement existing drinking-water supplies, MUD is constructing a new well field, the Platte River West Well Field, which will be located on the east and west sides of the Platte River near Wann, Nebraska (fig. FSP-1). The new well field, which will pump from the Platte River alluvial aquifer, will add an annual average of about 52 Mgal/d of water to the MUD system. MUD's Platte River West Well Field is expected to be operational in June 2008.

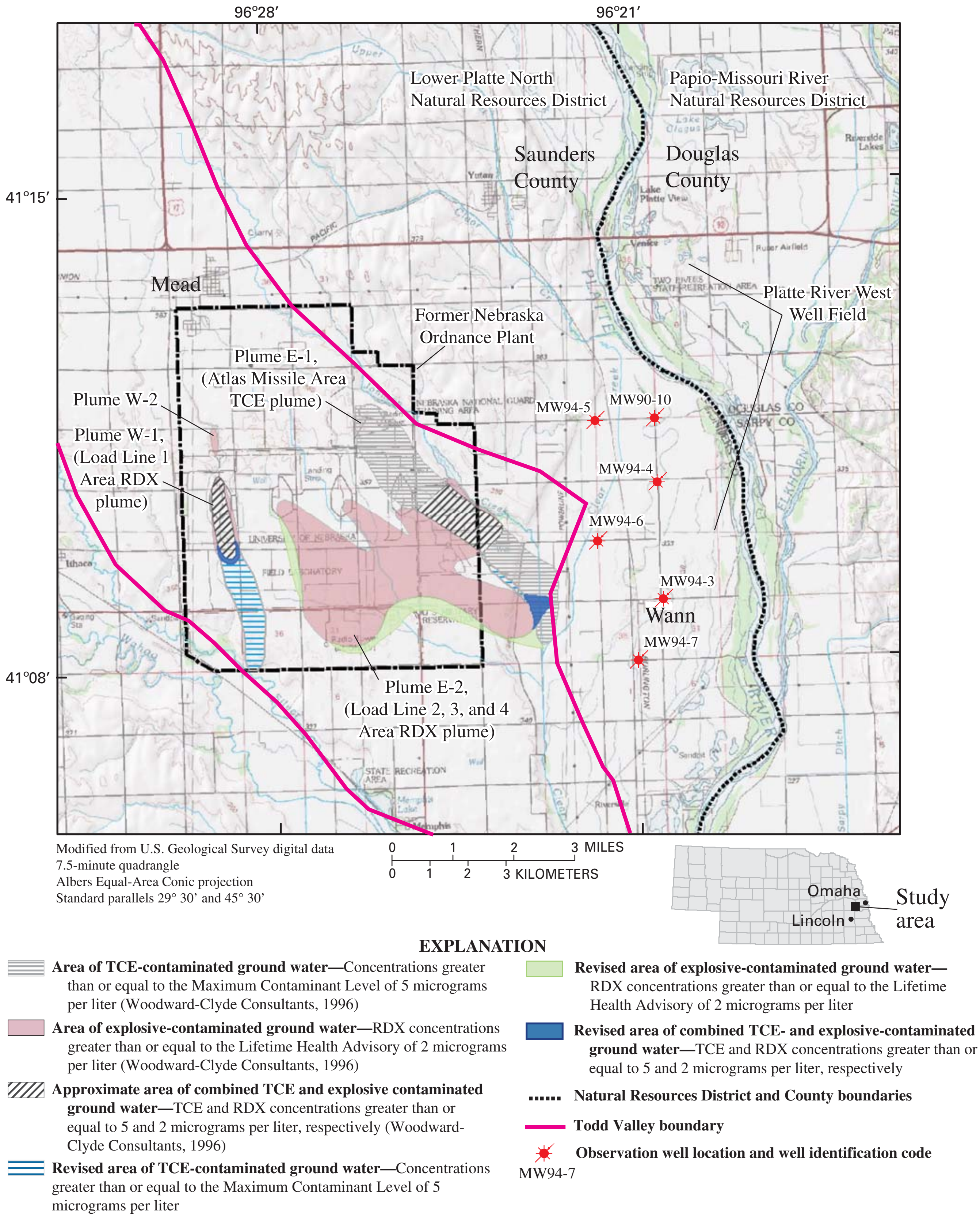


Figure FSP-1. Location of study area, approximate boundary of Todd Valley, and plumes of trichloroethylene (TCE)- and Royal Demolition Explosive (RDX)-contaminated ground water at former Nebraska Ordnance Plant (NOP) near Mead, Nebraska (Swinehart and others, 1994; Mary Lyle, U.S. Army Corps of Engineers, written commun., March 2005). Water quality criteria from USEPA (2004).

The Platte River West Well Field will be several miles east of the NOP site, which the U.S. Department of Defense (DOD) operated during and after World War II (fig. FSP-1). Part of the NOP site was later acquired and managed by the University of Nebraska—Lincoln (UNL) Agricultural Research and Development Center (ARDC), the boundaries of the ARDC area are not shown in figure FSP-1. Ground water beneath the site is contaminated by activities of DOD and its contractors and possibly may be contaminated by ARDC activities or the activities of other parties (USEPA, 2005). The contaminants of concern associated with the activities conducted at the former NOP include trichloroethylene (TCE) and explosives, such as Royal Demolition Explosive (RDX), also known as cyclonite or cyclotrimethylene trinitramine. The possible contaminants associated with ARDC's activities will be investigated by UNL; the investigation will be overseen by USEPA (USEPA, 2005).

MUD must design and manage the new well field in compliance with Section 404 of the Clean Water Act (CWA) (44 USC 1344). USACE, Omaha District, administers the day-to-day program, develops policy and guidance, and enforces Section 404 provisions. In May 2003, USACE, Omaha District, issued a Section 404 permit, No. 19910085, to MUD for construction of the new well field; in MUD's Section 404 permit, USACE, Omaha District, requires MUD to do at least 2 years of semiannual water-quality monitoring in a yet-unspecified set of wells or well nests for possible contaminants from NOP (USACE, 2003). Prior to sampling these wells, MUD must submit a SAP to USACE, Omaha District, for review and approval. The SAP will consist of two components—an FSP and a QAPP. The SAP must be in accordance with specified USACE and USEPA guidance (USACE, 2001; USEPA, 2001a, 2002). The laboratories used for analysis of the samples will have a documented quality-assurance (QA) system and will comply with USACE, ANSI/ASQC, and USEPA guidelines (ANSI/ASQC, 1995; USEPA, 2001b; USACE, 2001).

MUD has obtained permits for production wells in Saunders County from the LPNNRD; LPNNRD is responsible for protecting the quality and quantity of ground water in their district. When MUD received permits from LPNNRD for the new well field, LPNNRD required MUD to sample six specified observation wells annually for TCE and RDX. MUD identifies these six observation wells as MW90-10, MW94-3, MW94-4, MW94-5, MW94-6, and MW94-7 (fig. FSP-1). In response to the LPNNRD's sampling requirement, MUD asked USGS to sample these wells semiannually in accordance with MUD's Section 404 permit No. 199910085 requirements for future sampling of a yet-unspecified set of wells or well nests that will be located and constructed to USACE, Omaha District's specifications (USACE, 2003).

Ground-water quality will be monitored by collecting and analyzing two samples from six designated observation wells. Samples will be collected during four sampling periods—spring 2005, fall 2005, spring 2006, and fall 2006. The samples will be collected for analysis of VOCs and explosives in accordance with USGS sampling protocol (USGS, 1997-2005). NWQL will analyze spring 2005 samples for 61 VOC compounds using USGS's analysis method O-4127-96, Schedule 1380 (Connor and others, 1998; NWQL, 2004), and STL, Denver, Colorado, will analyze spring 2005 samples for 16 explosives compounds using STL's analysis method SW-846-8321A with solid-phase extraction (SPE) (USEPA, 1996c; Penfold, 2001; STL, 2003). Provided none of the VOC compounds associated with NOP are detected in the spring 2005 sampling, the compounds included in VOC analysis for subsequent sampling (fall 2005, spring 2006, and fall 2006) will be reduced from 61 VOC compounds to a method that includes seven selected VOC compounds (TCE, dichloropropane [1,2-], methylene chloride, dichloroethene [cis-1,2], trichloroethane [1,1,1-], xylene [total], and toluene), and the analysis method will be changed to STL's analysis method SW-846-8260B (USEPA, 1996b; STL, 2005). STL's analysis method SW-846-8260B (USEPA, 1996b; STL, 2005) costs less but has a higher laboratory reporting level (LRL) than the minimum reporting level (MRL) for USGS's analysis method O-4127-96 Schedule 1380 (Connor and others, 1998; NWQL, 2004). STL's analysis method SW-846-8260B (USEPA, 1996b; STL, 2005) will be used for subsequent sampling because VOC compounds are not expected to be detected in the MUD wells, which will be verified to a higher level of certainty with the results from USGS analysis results for method O-4127-96, Schedule 1380 (Connor and others, 1998; NWQL, 2004) in the spring 2005 sampling, and because of reduced laboratory analysis costs. If concentrations of TCE, RDX, dichloropropane [1,2-], and methylene chloride, are above the NWQL's MRL or STL's LRL in samples from any of the wells, resampling the wells with evidence of contamination to verify the results will be discussed with MUD. If resampling results also are above NWQL's MRL or STL's LRL, USGS will meet with MUD to determine subsequent action.

The fall 2005, spring 2006, and fall 2006 samples also will be analyzed by STL for 16 explosives compounds using STL Method 8321A with SPE (USEPA, 1996c; Penfold, 2001; STL, 2003). After each sampling, the analysis results will be reviewed, stored in the USGS National Water Information System (NWIS) database, and presented in a report on the World Wide Web, which is accessible by the public from the NWSC's home page (*http://ne.water.usgs.gov/index.htm*).

The FSP and QAPP for this project were written in accordance with USACE's Engineering Manual 200-1-3 (USACE, 2001), which incorporates the requirements of USEPA QA/R-5 and USEPA QA/G-5 (USEPA, 2001a, 2002), and DOD (2004). In this SAP, several types of samples are described—environmental, QA, and QC; these sample types are defined as follows:

- An environmental sample is a regular sample that is analyzed by the primary laboratory.
- A QA sample is a replicate of an environmental sample, except that the sample is analyzed by the regulating government agency's (USEPA or USACE) laboratory or by a laboratory designated by the regulating government agency. QA samples can provide early detection of sampling, documentation, packaging,

and/or shipping errors. Comparison of analytical results from environmental samples and from QA samples allows an independent assessment of the primary laboratory's performance.

- A QC sample can be one of several types of samples; QC samples are analyzed by the primary laboratory. QC samples used for this project include equipment blanks, field blanks, replicates, matrix spikes, and matrix spike duplicates; other QC samples may be source solution blanks, which are not required for the project, but may be collected at the Project Chief's discretion. The type of QC samples will not be identifiable by the primary laboratory. QC analysis results are used to assess the sampling precision and handling techniques of the primary laboratory.

Assumptions for the SAP are:

- QA samples will not be collected from the wells sampled for this project because the sampling is not required for MUD's Section 404 permit No. 199910085 (Rodney Schwartz, USACE, Omaha, Nebraska, oral commun., April 2005) or for USEPA's requirements. At a later date, USACE, Omaha District, will designate a set of wells to be sampled by MUD to comply with MUD's Section 404 permit No. 199910085 and will collect QA samples when MUD samples the wells designated for Section 404 permit No. 199910085 compliance (USACE, 2003).
- Chain-of-custody (COC) forms and procedures will be used when the samples are sent to NWQL. COC forms and procedures will not be used at NWQL after the samples are received by NWQL log-in personnel because the samples are not required for regulatory purposes and NWQL is in a secured Federal facility—visitors to NWQL are accompanied by laboratory personnel while in the laboratory facilities. At NWQL, the sample will be handled according to standard procedures and will be disposed of in accordance with NWQL's hazardous waste procedures. COC forms and procedures will be used at STL until the samples are consumed or disposed of in accordance with STL's hazardous waste procedures.

The results of the project will provide MUD and the public with reliable and impartial information on ground-water-quality conditions near MUD's new well field. This information will help MUD and other Federal, State, and local agencies make informed decisions on ground-water management issues related to the well field and to other ground-water use in the area. The project also will add to USGS's water-quality database and assist USGS in understanding and describing the Nation's water resources.

FSP 1.1 Site History and Potential Contaminants

MUD's Platte River West Well Field is several miles east of NOP (fig. FSP-1). NOP is located 0.5 mi south of Mead, 30 mi west of Omaha, and 35 mi northeast of Lincoln, Nebraska. NOP consists of 17,258 acres of which approximately 9,000 acres currently (2005) are owned by ARDC and the remainder are owned by private individuals and corporations. Land use at the site is mixed but primarily agricultural.

From 1942 through 1945, NOP was a munitions load, assemble, and pack facility that included bomb load lines, an ammonium nitrate production plant, a bomb booster assembly plant, explosive burning areas, a sewage treatment plant, landfill, culvert area, turnout area, storage and administrative facilities, and analytical laboratories. Bombs, boosters, and shells generally were produced from raw materials fabricated at other locations, except during the first months of operation in 1942, when ammonium nitrate was produced onsite. In 1950, NOP was used to assemble bombs, shells, rockets, warheads, block-cast trinitrotoluene (TNT), supplementary charges, and boosters. The plant was deactivated in 1956. In 1959, 2,000 acres of NOP were granted to the U.S. Air Force for construction of an Atlas missile site. The missile site was abandoned in 1964. Fireworks were produced in the former bomb booster assembly plant between 1969 and 1989. In the 1970s, ARDC operated several small solid-waste management facilities in their part of NOP. These solid-waste management areas included trenches used to dispose of low- and medium-level radioactive waste, laboratory waste, other chemical waste, radioactive animal carcasses, a pesticide rinsate area, and other solid waste (TechLaw, 2004).

The area that encompasses both NOP and MUD's Platte River West Well Field is underlain by limestone and shale bedrock of Pennsylvanian age. In the NOP area, Dakota Sandstone of Early Cretaceous age overlies the Pennsylvanian bedrock; in MUD's Platte River West Well Field area, the Dakota Sandstone has been eroded (Souders, 1967).

The NOP area overlies a geographic and physiographic area knows as "Todd Valley" (Condra, 1903) (fig. FSP-1). Todd Valley, which is 20 to 80 ft above the modern Platte River flood plain, is an abandoned channel of the Platte River. Todd Valley is Quaternary flood-plain and alluvial deposits of clay, silt, sand, and gravel that overlie the Dakota Sandstone. The land surface in the NOP area is mantled with loess deposits of Quaternary age. In the Platte River West Well Field area, Quaternary alluvial and flood-plain deposits of clay, silt, sand, and gravel directly overlie Pennsylvanian bedrock (Souders, 1967).

The primary aquifers underlying the NOP and MUD Platte River West Well Field areas are the paleovalley alluvial aquifer, which consists of alluvial and flood-plain deposits in the Todd Valley area (in this report, referred to as the paleovalley alluvial aquifer) and the Platte River alluvial aquifer, which consists of alluvial and flood-plain deposits (Ellis and others, 1985); the paleovalley alluvial aquifer, Platte River alluvial aquifer, and High Plains aquifer to the west are hydrologically connected. Ground-water flow in the paleovalley alluvial aquifer has been described by Souders (1967). Near NOP, ground water in the paleovalley alluvial aquifer generally flows southeast toward the Platte River; however, near principal streams, ground water

flows toward the streams. Recharge to the paleovalley alluvial aquifer is primarily from precipitation. Ground-water flow in the Platte River alluvial aquifer generally parallels the river. The sources of recharge to the Platte River alluvial aquifer are precipitation, inflow from the paleovalley alluvial and High Plains aquifers, and inflow from the Platte River (Souders, 1967; Steele and Verstraeten, 1999; Summerside, 2001; Steele, 2002). The paleovalley and Platte River alluvial aquifers both supply water for domestic, irrigation, and municipal uses.

Contaminants in ground water from NOP activities are migrating primarily in four separate plumes (Woodward-Clyde Consultants, 1996)—referred to in this report as Plumes W-1, W-2, E-1, and E-2 (fig. FSP-1). The parent contaminants are TCE, which is a solvent, and RDX, which is a conventional warfare material. The source of the eastern TCE plume (E-1) is the Atlas missile area; this plume is migrating in a southeasterly direction. The source of the RDX plume (E-2) is NOP's Load Lines 2, 3, and 4; this plume is mitigating in an easterly direction. The eastern TCE and RDX plumes (E-1 and E-2) have intersected each other near the east-central boundary of NOP. The source of the western plumes of TCE and RDX (W-1) is NOP's Load Line 1. Contaminant migration from ARDC area is not well defined and is not addressed in this project.

FSP 1.2 Summary of Previous Studies

The wells to be sampled are located between the NOP and MUD's Platte River West Well Field (fig. FSP-1). Descriptions of previous NOP studies are included in the following reports:

- Remedial investigation (Woodward-Clyde Consultants, 1993)
- Feasibility study (Woodward-Clyde Consultants, 1995a)
- Proposed plan (Woodward-Clyde Consultants, 1995b)
- Record of decision (Woodward-Clyde Consultants, 1996)
- Ground-water annual report (Woodward-Clyde Consultants, 1999; URS Greiner Woodward Clyde Federal Services, 2000; URS Group, Incorporated, 2001; Environmental Chemical Corporation, 2003)

Analysis results from MUD's production wells that are in the area are available from MUD upon request.

FSP 1.3 Site-Specific Definition of Problems

Potential onsite conditions that could result in challenging sample collection include low temperatures during winter months and high temperatures during spring and summer months. The low temperatures could result in freezing of the steam-cleaner water-supply lines; insulating the steam-cleaner lines and emptying the water tank daily would address this concern. The high temperatures will necessitate putting the samples in a cooler with a substantial quantity of ice immediately after collection and repacking the samples for shipping with fresh ice in coolers with extra insulation.

Chemical analyses will be performed by NWQL and STL. To avoid potential laboratory problems, such as missed holding times, failure to meet QAPP criteria limits, failure to complete the corrective actions specified in QAPP, and insufficient sample for reanalysis of explosives, samples will be collected early in the week to allow maximum time for multiple laboratory analyzes or reanalysis with the extra sample bottles that will be sent to the laboratories.

Project-derived wastewater will be produced from the sampling process. Project-derived wastewater will be containerized and screened for VOCs onsite with a photoionization detector or similar meter. If VOCs are not detected, the water will be disposed of on the ground. This methodology is similar to procedures used by USACE, Kansas City District contractors, at wells downgradient from NOP plumes and upgradient from MUD observation wells. Results of analysis reported by these USACE contractors indicate no detection of contaminants of concern from NOP (M. Lyle, USACE, written commun., March 2005). This approach will be reexamined if analytical results for TCE, RDX, dichloropropane [1,2-], and methylene chloride from samples collected at MUD observation wells indicate concentrations greater than NWQL's MRL or STL's LRL or if subsequent USACE contractor's analytical results for contaminants of concern from NOP show concentrations greater than the NWQL's MRL or STL's LRL.

FSP 2.0. Project Organization and Responsibilities

The organizations involved with sampling MUD wells are listed in table FSP-1.

The roles and responsibilities for key personnel involved in this project have been designated within MUD, STL, and USGS (table FSP-2). These personnel may be replaced with appropriately qualified personnel, if necessary. For a description of the responsibilities of key personnel in the laboratories, the reader should refer to section "QAPP 1.0" of this report.

Personnel who do the sample collections will have completed USGS training course "Field Water-Quality Methods for Ground Water and Surface Water" (course QW1028, USGS National Training Center, Denver, Colorado). Course attendance is documented in each person's USGS personnel file, which is maintained by the Administrative Section of NWSC. The Project Chief will be responsible for ensuring that the personnel who do the sample collection have completed the course QW1028.

Personnel who collect data that are stored in the USGS NWIS database also are required to participate in the National Field Quality Assurance (NFQA) Program (Stanley and others, 1998). The NWSC Water-Quality Specialist is responsible for ensuring that applicable field personnel participate in the NFQA program.

Table FSP-1. List of organizations and organization responsibilities during this project.

[MUD, Metropolitan Utilities District; LPNNRD, Lower Platte North Natural Resources District; USACE, U.S. Army Corps of Engineers; CWA, Clean Water Act; QA, quality assurance; USGS, U.S. Geological Survey; NWSC, Nebraska Water Science Center; NWQL, National Water Quality Laboratory; VOC, volatile organic compound; STL, Severn Trent Laboratory]

Organization	Responsibilities
MUD, Omaha, Nebraska	• Responsible for supporting this ground-water sampling project in response to requirements in MUD's permit for the Platte River West Well Field from LPNNRD.
	• Provides access to observation wells.
LPNNRD Wahoo, Nebraska	• Responsible for protecting the quality and quantity of water supplies within LPNNRD boundaries.
	• Issued permit to MUD for wells in Platte River West Well Field that are located in Saunders County, Nebraska.
USACE, Omaha District Omaha, Nebraska	• Responsible for enforcing Section 404 of the CWA.
	• Responsible for arranging for analysis of QA samples, if any, and reporting the results.
USGS, NWSC Lincoln, Nebraska	• Responsible for overall phases of work and primary contact for project activities.
	• Coordination and execution of all onsite ground-water sampling activities.
	• Sample-collection management.
	• Data analysis and interpretation.
	• Data review.
	• Report results to MUD, LPNNRD, USACE, and public.
	• Data verification.
NWQL Denver, Colorado	• Analytical services for VOCs.
STL Denver, Colorado	• Analytical services for VOCs and explosives.

Table FSP-2. Key personnel involved in the project and their responsibilities.

[MUD, Metropolitan Utilities District; LPNNRD, Lower Platte North Natural Resources District; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; NWQL, National Water Quality Laboratory; STL, Severn Trent Laboratory; USACE, U.S. Army Corps of Engineers; QC, quality control; SAP, Sampling and Analysis Plan; FSP, Field Sampling Plan; QAPP, Quality-Assurance Project Plan; NWIS, National Water Information System; QA, quality assurance; NWSC, Nebraska Water Science Center]

Key personnel	Organization	Role	Responsibility
Kevin Tobin	MUD	MUD Project Manager	Responsible for supporting this ground-water sampling project in response to requirements in MUD's permit from LPNNRD for wells in MUD’s Platte River West Well Field.
Virginia L. McGuire	USGS	Project Chief and Lead for field activities	Primary contact point with USEPA; MUD; NWQL; STL; USACE, Kansas City District; and USACE, Omaha. Overall responsibility for all phases of work, including personnel, scheduling, data verification, and budget control. Manage and coordinate field work. Prepares QC summary report, if applicable. Prepare data report of results for USEPA, MUD, USACE, and the public.
Jill D. Frankforter	USGS	Water Quality Specialist	Peer reviewer of SAP, including FSP and QAPP. One of two peer reviewer of data report of results to MUD and data release to NWIS Web site. The other peer reviewer will be determined later. QA and QC oversight for USGS NWSC.
Timothy P. Boyle	USGS	Safety Officer	Overall responsibility for Health and Safety Program for USGS NWSC.
Dwain Curtis	USGS	Data Manager	Responsible for laboratory data retrieval and NWIS data entry and QC.
Thomas J Maloney	USGS	NWQL QA Manager	Oversees QA Program at NWQL.
Michael Schmitt	STL	STL QA Manager	Oversees QA Program at STL.
Wayne Scott	STL	USGS contact at STL	Oversees USGS contract activities at STL.
Richard L. Daddow	USGS	Liaison between USGS and STL	Reviews and evaluates STL analytical results and data deliverables for conformance to USGS contract with STL.

FSP 3.0 Project Scope and Objectives

The scope of this project is to:

- Collect ground-water samples from six designated wells during four sampling periods over 2 years;
- Analyze the samples for VOCs and explosives;
- Review the analysis results; and
- Report the analysis results to MUD and the public.

Ground-water samples will be collected during spring 2005, fall 2005, spring 2006, and fall 2006. During each sampling period, ground-water samples will be collected at two depths in the six designated wells.

The objective of the project is to monitor for the presence of VOC and explosive compounds from the NOP site in the ground water upgradient from the Platte River West Well Field.

FSP 3.1 Task Descriptions

The tasks included in this project for each sampling period are:

- Task 1. Measure water levels and collect samples at two discrete depths in six designated observation wells (fig. FSP-1). The two samples will be collected using pneumatic packers (hereafter referred to as packers)—one sample from near the top of the well screen and one sample from near the bottom of the well screen.
- Task 2. Analyze the samples for VOCs and explosives.
- Task 3. Review and validate the analysis results.
- Task 4. Report the results to USEPA, LPNNRD, MUD, USACE-Omaha District, and the public through USGS annual data report and NWIS Web site.

FSP 3.2 Applicable Regulations and Standards

The project will comply with all applicable regulations and standards, including those of USGS, USACE, USEPA and Office of Safety and Health Administration.

FSP 3.3 Project Schedule

The project will be performed between January 2005 and December 2006 (fig. FSP-2).

FSP 4.0 Nonmeasurement Data Acquisition

The only nonmeasurement data acquisition will be to obtain the well-construction information and landowner names from MUD.

FSP 5.0 Ground-Water Sampling Activities

Discussed in this section are the wells to be sampled, water-quality constituents to be analyzed, frequency of sampling and analysis, QC samples to be collected, field procedures to be followed, and decontamination procedures to be conducted for ground-water sampling activities for this project.

FSP 5.1 Rationale

LPNNRD identified the wells to be sampled and the analyses to be performed as required for MUD's Platte River West Well Field permit from the LPNNRD. MUD specified that USGS follow USACE-Omaha District's requirements for sampling yet-unspecified observation wells that will be required for MUD's Section 404 permit No. 199910085 (USACE, 2003).

FSP 5.1.1 Observation Well Location and Construction

A set of six MUD observation wells, which were specified by LPNNRD, will be sampled in 2005 and 2006. MUD's identification codes for the six wells are MW90-10, MW94-3, MW94-4, MW94-5, MW94-6, and MW94-7 (fig. FSP-1). The wells are all constructed with 4-in. polyvinyl chloride (PVC) casing and slotted screens. The well screens are 30 to 50 ft long; one well, MW90-10, is screened at two intervals (table FSP-3). All of the wells are screened in the Platte River alluvial aquifer.

FSP 5.1.2 Sample Collection and Field and Laboratory Analysis

Four ground-water samplings will be conducted—in spring 2005, fall 2005, spring 2006, and fall 2006. Ground-water samples will be collected using low-flow sampling methods at two discrete depths from the designated observation wells using packers to isolate zones of interest. One sample will be collected from near the top of each well's screened interval, and one sample will be collected from near the bottom of each well's screened interval. The environmental samples should be representative of ground-water conditions in the approximate 2-ft screened interval between the packers. The packers will be set near the top and bottom of the screened interval in each well; the approximate depth of the sample intervals for each well and the associated sample identification number for each sample are listed in table FSP-4. NWQL and STL will analyze the samples using methods described in table FSP-5.

	==========2005===========												==========2006===========											
	FY2005									FY2006												FY2007		
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Write SAP																								
Prepare SAP, which consists of FSP and QAPP	X	X	X	X																				
Submit SAP to USEPA, USACE, and USGS for review				X	X	X	X	X	X															
Respond to review comments on SAP					X	X	X	X	X															
Publish SAP as USGS Open-File Report on Web									X															
First round of sampling																								
Prepare for sampling 1st time						X																		
Collect equipment blank and send for VOC analysis to NWQL						X																		
After approval of SAP, sample wells 1st time; send samples to NWQL and STL						X																		
Review laboratory results; if necessary, request reanalysis							X	X																
Send laboratory results to MUD for review							X	X																
Publish results after review on Web page									X	X														
Second to fourth round of sampling																								
Prepare for sampling 2nd, 3rd, and 4th time								X						X	X					X				
If scheduled, collect equipment blank and send for VOC analysis to NWQL														X										
Sample wells; send samples to STL								X	X						X					X	X			
Review laborarory results; if necessary, request reanalysis										X	X					X	X					X	X	
Send laboratory results to MUD for review										X	X					X	X					X	X	
Publish results after review on Web page												X	X					X	X					X

Figure FSP-2. Chart showing workplan (SAP, Sampling and Analysis Plan; FSP, Field Sampling Plan; QAPP, Quality-Assurance Project Plan; USEPA, U.S. Environmental Protection Agency; USACE, U.S. Army Corps of Engineers; USGS, U.S. Geological Survey; VOC, volatile organic compound; NWQL, USGS National Water Quality Laboratory, Denver, Colorado; STL, Severn Trent Laboratory, Denver, Colorado; MUD Metropolitan Utilities District).

Table FSP-3. Observation well construction and lithologic information (Kevin Tobin, MUD, written commun., June 2004).

[MUD, Metropolitan Utilities District; NAVD 88, North American Vertical Datum of 1988]

Well identification code (assigned by MUD)	Well registration number (assigned by Nebraska Department of Natural Resources)	Altitude of top of outer casing (feet above NAVD 88)	Inside diameter of well screen and casing (inches)	Well depth (feet)	Depth to top of screened interval (feet below land surface)	Depth to bottom of screened interval (feet below land surface)	Screen length (feet)	Information from driller's logs		
								Depth from top of interval (feet below land surface)	Depth to bottom of interval (feet below land surface)	Lithologic description
MW90-10	as assigned	1,102.58	4	97	17	47	30	0	3	Topsoil
					67	97	30	3	15	Fine and coarse sand
								15	97	Fine and coarse sand and gravel
MW94-3	as assigned	1,088.77	4	94	54	94	40	0	4	Silty sandy soil
								4	20	Coarse and fine sand
								20	28	Gray clay
								28	94	Coarse sand and gravel
								94	100	Limestone
MW94-4	as assigned	1,097.76	4	90	50	90	40	0	3	Sandy soil
								3	20	Coarse and fine sand
								20	89	Coarse sand and gravel
								89	90	Rough boulders
MW94-5	as assigned	1,100.59	4	60	40	60	20	0	15	Gray clay
								15	20	Fine and coarse sand
								20	54	Coarse and fine sand and gravel
								54	58	Sandy gray clay
								58	60	Orange shale
MW94-6	as assigned	1,089.20	4	95	45	95	50	0	4	Gray clay
								4	20	Fine and coarse sand
								20	95	Coarse sand with fines
								95	97	Gray shale
MW94-7	as assigned	1,086.04	4	90	50	90	40	0	3	Fine sand
								3	11	Silty clay
								11	67	Coarse sand and gravel
								67	69	Light gray clay
								69	87	Coarse and fine sand and gravel
								87	90	Coarse orange sandstone

Table FSP-4. Observation well short name, registration number, and site identification number for each well to be sampled and approximate interval to be sampled, medium code, and sample type in the National Water Information System for environmental samples from each observation well.

[NWIS, National Water Information System]

Well short name (assigned by the Metropolitan Utilities District)	Well registration number (assigned by the Nebraska Department of Natural Resources)	Site identification number (assigned by the U.S. Geological Survey)	Interval sampled	Approximate depth to the top of the sample interval (feet below land surface)[1]	Approximate depth to the bottom of the sample interval (feet below land surface)[1]	Date and time sampled	Medium code[2]	Sample type in NWIS[3]
MW90-10-shallow	as assigned	as assigned	shallow	20	22	Date Time	6	7 or 9
MW90-10-deep	as assigned	as assigned	deep	91	93	Date Time	6	7 or 9
MW94-3-shallow	as assigned	as assigned	shallow	57	59	Date Time	6	7 or 9
MW94-3-deep	as assigned	as assigned	deep	88	90	Date Time	6	7 or 9
MW94-4-shallow	as assigned	as assigned	shallow	53	55	Date Time	6	7 or 9
MW94-4-deep	as assigned	as assigned	deep	84	86	Date Time	6	7 or 9
MW94-5-shallow	as assigned	as assigned	shallow	43	45	Date Time	6	7 or 9
MW94-5-deep	as assigned	as assigned	deep	51	53	Date Time	6	7 or 9
MW94-6-shallow	as assigned	as assigned	shallow	48	50	Date Time	6	7 or 9
MW94-6-deep	as assigned	as assigned	deep	89	91	Date Time	6	7 or 9
MW94-7-shallow	as assigned	as assigned	shallow	53	55	Date Time	6	7 or 9
MW94-7-deep	as assigned	as assigned	deep	84	86	Date Time	6	7 or 9

[1]The actual depth may vary slightly; the actual depth sampled will be recorded in the NWIS database.

[2]6, ground water.

[3]In NWIS, the sample type is 7 for environmental samples with replicates and 9 for environmental samples without replicates. The sample type will be 9 for all samples on the forms sent to the laboratories.

Table FSP-5. Sampling period, analytical laboratories, analytes, and laboratory analysis methods to be used.

[NWQL, National Water Quality Laboratory, Denver, Colorado; VOC, volatile organic compounds; STL, Severn Trent Laboratory, Denver, Colorado; SPE, solid-phase extraction]

Sampling period	Analytical laboratory	Analytes	Laboratory analysis methods
Spring 2005	NWQL	VOCs (61 total)	Schedule 1380, which uses NWQL Method O-4127-96.[1]
	STL	Explosives	SW 846-8321A with SPE.[2]
Fall 2005, spring 2006, fall 2006	STL	Selected VOCs (7) and explosives	SW 846-8260B[3] for VOCs and SW 846-8321A with SPE[2] for explosives.

[1]Connor and others (1998) and NWQL (2004).

[2]USEPA (1996c), Penfold (2001), and STL (2003).

[3]USEPA (1996b) and STL (2005).

Temporal conditions, such as seasonal local or regional declines in the water-table altitude are not expected to affect water levels in these wells because nearby irrigation wells should not be operating during the sampling periods (fig. FSP-3) and because long-term and annual water-level changes are not evident in the area (University of Nebraska—Lincoln, Conservation and Survey Division, 2005a, 2005b).

The samples from the spring 2005 sampling will be sent to NWQL for VOC analysis using method O-4127-96, Schedule 1380 (Connor and others, 1998; NWQL, 2004) (table FSP-6) and to STL for explosive analysis using method SW-846-8321A with SPE (USEPA, 1996c; Penfold, 2001; STL, 2003) (table FSP-7). The samples from the fall 2005, spring 2006, and fall 2006 samplings will be sent to STL for abbreviated VOC analysis using method SW-846-8260B (USEPA, 1996b; STL, 2005) (table FSP-8) and for explosive analysis using method SW-846-8321A with SPE (USEPA, 1996c; Penfold, 2001; STL, 2003) (table FSP-7). The abbreviated VOC analysis by STL of seven analytes will include TCE, dichloropropane [1,2-], methylene chloride, dichloroethene [cis-1,2], trichloroethane [1,1,1-], xylene [total], and toluene.

FSP 5.1.3 Upgradient Wells, QA/QC, and Blank Samples

No upgradient wells at NOP will be sampled for this project; however, USACE, Kansas City District, samples upgradient wells quarterly. The results of analyses from these wells will be reviewed when they are available.

QA samples will not be collected by USACE for this project because these samples are not required by MUD’s 404 permit No. 199910085 (Rodney Schwartz, USACE, oral commun., April 2005). QC samples that will be collected for this project include equipment blanks, replicates, field blanks, trip blanks, laboratory matrix spikes, and laboratory matrix spike duplicates (table FSP-9) and may include a source solution blank. Equipment blanks will be collected using packers and a Bennett sample® pump. The replicate samples will be collected after the associated environmental sample. For each sampling period, blank QC samples generally will be collected after the second sample at the first well sampled and prior to the first sample at the last well sampled; replicate QC samples will be collected at a well and depth interval selected on a random basis.

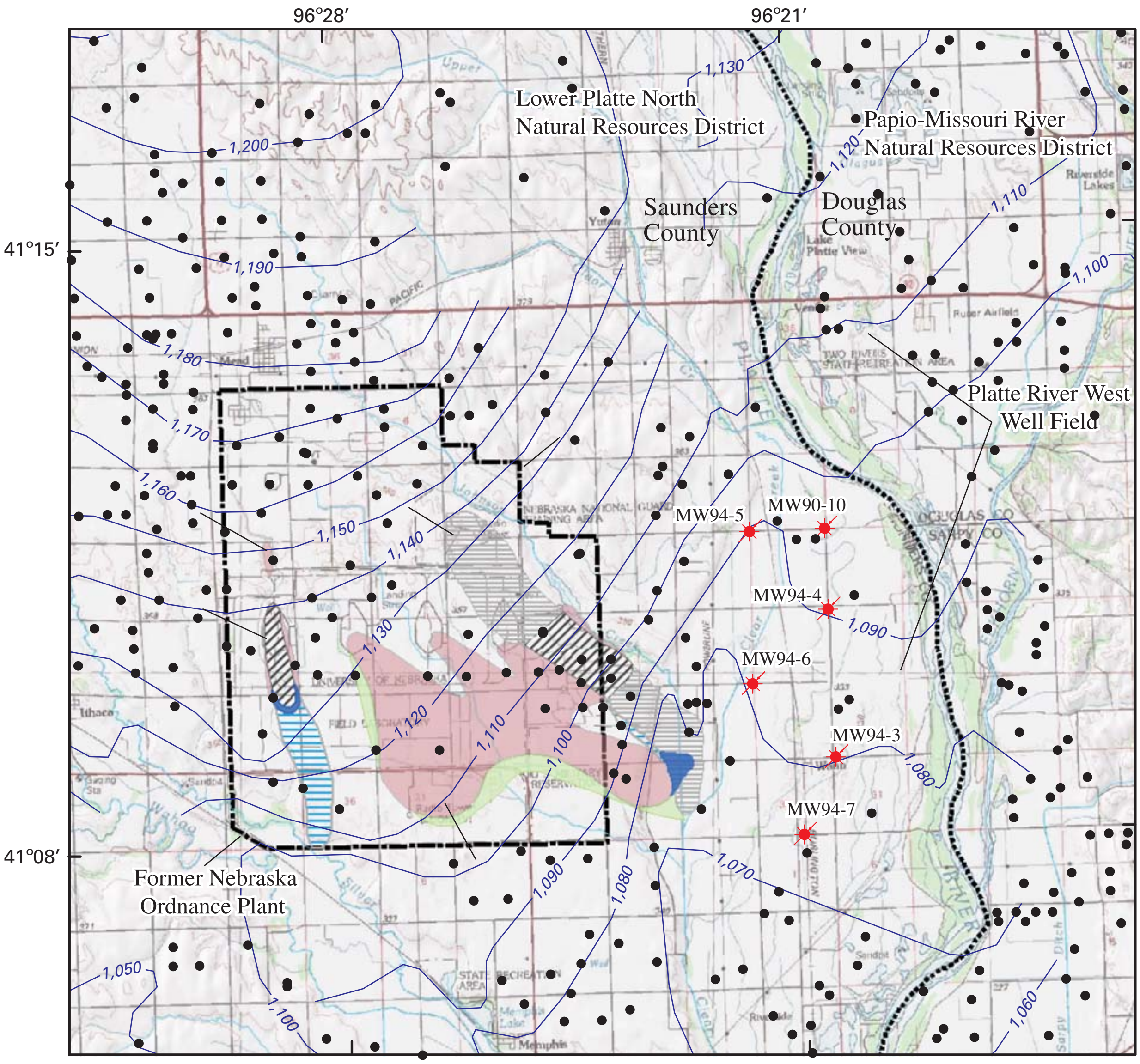
Trip blank samples for VOC analysis will be provided by the analytical laboratories in the same sample containers as those supplied for the environmental VOC samples. For each sampling period, a trip blank for VOC analysis will be sent in the first cooler sent to the laboratory.

FSP 5.2 Presence of Free Product

The presence of free product—VOC or explosives—is not expected in the wells that will be sampled for this project based on a review of USACE, Kansas City District, results of analysis in samples collected from upgradient wells.

FSP 5.3 Field Measurement Procedures and Criteria

The field measurement procedures to be used in this project consist of (1) measuring the water level in each well prior to, during, and after sampling the well; (2) measuring physical properties of the water— specific conductance, pH, temperature, turbidity, and dissolved oxygen (DO)—while pumping water from the well to remove stagnant water from the well casing; (3) measuring the barometric pressure, and (4) screening the project-derived wastewater with a photoionzation detector or similar meter for evidence of VOC compounds.



Modified from U.S. Geological Survey digital data, 7.5-minute quadrangle
Albers Equal-Area Conic projection
Standard parallels 29° 30' and 45° 30'

EXPLANATION

Area of TCE-contaminated ground water—Concentrations greater than or equal to the Maximum Contaminant Level of 5 micrograms per liter (Woodward-Clyde Consultants, 1996)

Area of explosive-contaminated ground water—RDX concentrations greater than or equal to the Lifetime Health Advisory of 2 micrograms per liter (Woodward-Clyde Consultants, 1996)

Approximate area of combined TCE and explosive contaminated ground water—TCE and RDX concentrations greater than or equal to 5 and 2 micrograms per liter, respectively (Woodward-Clyde Consultants, 1996)

Revised area of TCE-contaminated ground water—Concentrations greater than or equal to the Maximum Contaminant Level of 5 micrograms per liter

Revised area of explosive-contaminated ground water—RDX concentrations greater than or equal to the Lifetime Health Advisory of 2 micrograms per liter

Revised area of combined TCE- and explosive-contaminated ground water—TCE and RDX concentrations greater than or equal to 5 and 2 micrograms per liter, respectively

Natural Resources District and County boundaries

1,200 **Water-table contour**—Shows altitude of water table, 1995. Contour interval 10 feet. Datum is National Geodetic Vertical Datum of 1929 (NGVD 29)

MW94-7 **Observation well location and well identification code**

Active irrigation well

Figure FSP-3. Location of active irrigation wells (Nebraska registered well data on Web at *http://dnrdata.dnr.state.ne.us/wellssql/*), regional water-table altitude for 1995 (Summerside, 2001), and plumes of trichloroethylene (TCE)- and Royal Demolition Explosive (RDX)-contaminated ground water at former Nebraska Ordnance Plant (NOP) near Mead, Nebraska (Mary Lyle, U.S. Army Corps of Engineers, written commun., March 2005). Water quality criteria from USEPA (2004).

Table FSP-6. Volatile organic compounds included in National Water Quality Laboratory's Method O-4127-96, Schedule 1380, with minimum reporting levels, and U.S. Environmental Protection Agency Maximum Contaminant Levels or treatment techniques.

[CAS, Chemical Abstract Service; NWQL, National Water Quality Laboratory, Denver, Colorado; MRL, minimum reporting level; µg/L, micrograms per liter; USEPA, U.S. Environmental Protection Agency; MCL, Maximum Contaminant Level; TT, treatment technique; --, no MCL or TT available; MCLG, Maximum Contaminant Limit Goal]

Analyte	CAS number	NWQL	USEPA
		MRL[1] (µg/L)	MCL or TT[2] (µg/L)
Acrylonitrile	107-13-1	2.5	--
Benzene	71-43-2	.1	5
1,2,3-Trichlorobenzene	87-61-6	.2	--
1,2,4-Trichlorobenzene	120-82-1	.2	70
Bromobenzene	108-86-1	.2	--
Chlorobenzene	108-90-7	.1	100
Ethylbenzene	100-41-4	.1	700
1,3-Dichlorobenzene (m-)	541-73-1	.1	--
Butylbenzene	104-51-8	.2	--
n-Propylbenzene	103-65-1	.2	--
1,2-Dichlorobenzene (o-)	95-50-1	.1	600
1,4-Dichlorobenzene (p-)	106-46-7	.1	75
sec-Butylbenzene	135-98-8	.2	--
tert-Butylbenzene	98-06-6	.2	--
Bromoform[3]	75-25-2	.2	--
Hexachlorobutadiene	87-68-3	.2	--
Tetrachloromethane	56-23-5	.2	5
Chloroform[3]	67-66-3	.1	--
Isopropylbenzene	98-82-8	.2	--
1,1,1,2-Tetrachloroethane	630-20-6	.2	--
1,1,1-Trichloroethane	71-55-6	.1	200
1,1,2-Trichlorotrifluoroethane	76-13-1	.1	--
1,2-Dibromoethane	106-93-4	.2	0.05
1,2-Dichloroethane	107-06-2	.2	5
1,1,2,2-Tetrachloroethane	79-34-5	.2	--

Table FSP-6. Volatile organic compounds included in National Water Quality Laboratory's Method O-4127-96, Schedule 1380, with minimum reporting levels, and U.S. Environmental Protection Agency Maximum Contaminant Levels or treatment techniques.—Continued

[CAS, Chemical Abstract Service; NWQL, National Water Quality Laboratory, Denver, Colorado; MRL, minimum reporting level; µg/L, micrograms per liter; USEPA, U.S. Environmental Protection Agency; MCL, Maximum Contaminant Level; TT, treatment technique; --, no MCL or TT available; MCLG, Maximum Contaminant Limit Goal]

Analyte	CAS number	NWQL MRL[1] (µg/L)	USEPA MCL or TT[2] (µg/L)
Chloroethane	75-00-3	.2	--
cis-1,2-Dichloroethene	156-59-2	0.1	70
Tetrachloroethylene	127-18-4	.1	5
trans-1,2-Dichloroethylene	156-60-5	.1	100
Trichloroethene (TCE)	79-01-6	.1	5
1,1-Dichloroethane	75-34-3	.1	--
1,3,5-Trimethylbenzene	108-67-8	.2	--
Bromochloromethane	74-97-5	.2	--
Bromodichloromethane[3]	75-27-4	.1	--
Dibromochloromethane[3]	124-48-1	.2	--
Dichlorodifluoromethane	75-71-8	.2	--
Trichlorofluoromethane	75-69-4	.2	--
Bromomethane	74-83-9	.3	--
Chloromethane	74-87-3	.2	--
tert-Butyl methyl ether	1634-04-4	.2	--
Dibromomethane	74-95-3	.2	--
Dichloromethane (methylene chloride)	75-09-2	.2	5
Naphthalene	91-20-3	.5	--
4-Isopropyl-1-methylbenzene	99-87-6	.2	--
1,2,3-Trichloropropane	96-18-4	.2	--
1,3-Dichloropropane	142-28-9	.2	--
2,2-Dichloropropane	594-20-7	.2	--
1,2-Dibromo-3-chloropropane	96-12-8	.5	0.2
1,1-Dichloropropene	563-58-6	.2	--
cis-1,3-Dichloropropene	10061-01-5	.2	--

Table FSP-6. Volatile organic compounds included in National Water Quality Laboratory's Method O-4127-96, Schedule 1380, with minimum reporting levels, and U.S. Environmental Protection Agency Maximum Contaminant Levels or treatment techniques.—Continued

[CAS, Chemical Abstract Service; NWQL, National Water Quality Laboratory, Denver, Colorado; MRL, minimum reporting level; µg/L, micrograms per liter; USEPA, U.S. Environmental Protection Agency; MCL, Maximum Contaminant Level; TT, treatment technique; --, no MCL or TT available; MCLG, Maximum Contaminant Limit Goal]

Analyte	CAS number	NWQL	USEPA
		MRL[1] (µg/L)	MCL or TT[2] (µg/L)
trans-1,3-Dichloropropene	10061-02-6	.2	--
1,2-Dichloropropane	78-87-5	.1	5
1,2,4-Trimethylbenzene	95-63-6	.2	--
Styrene	100-42-5	.1	100
Toluene	108-88-3	.1	1,000
2-Chlorotoluene	95-49-8	.2	--
4-Chlorotoluene	106-43-4	.2	--
Vinyl chloride	75-01-4	.2	2
1,1,2-Trichloroethane	79-00-5	.2	5
1,1-Dichloroethylene	75-35-4	.1	7
Xylene [total]	1330-20-7	.2	10,000

[1]Childress and others (1999) and NWQL (2004).

[2]USEPA (2004).

[3]A trihalomethane—although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants.

Table FSP-7. Volatile organic compounds included in Severn Trent Laboratory's USEPA Method SW-846-8260B with laboratory reporting levels, method detection limits, and U.S. Environmental Protection Agency Maximum Contaminant Levels or treatment techniques.

[CAS, Chemical Abstract Service; STL, Severn Trent Laboratory, Denver, Colorado; LRL, laboratory reporting level; µg/L, micrograms per liter; MDL, method detection limit; USEPA, U.S. Environmental Protection Agency; MCL, maximum contaminant level; TT, treatment technique; --, no MCL or TT available]

Analyte	CAS number	STL		USEPA
		LRL (µg/L)[1]	MDL (µg/L)[1]	MCL or TT[2] (µg/L)
Dichloroethane [1,1-]	75-34-3	1	0.16	-
Dichloroethane [1,2-]	107-06-2	1	.13	5
Dichloroethene [1,1-]	75-35-4	1	.14	7
Dichloroethene [cis-1,2-]	156-59-2	1	.15	70
Dichloroethene [trans-1,2-]	156-60-5	1	.15	100
Dichloroethene [total 1,2-]	540-59-0	1	.15	-
Dichloropropane [1,2-]	78-87-5	1	.13	5
Dichloropropene [cis-1,3-]	10061-01-5	1	.16	-
Ethylbenzene	100-41-4	1	.16	700
Hexanone [2-]	591-78-6	5	1.4	-
Methyl-2-pentanone [4-]	108-10-1	5	.49	-
Methyl-tert-butyl ether (MTBE)	1634-04-4	5	.25	-
Methylene chloride	75-09-2	5	.32	5
Styrene	100-42-5	1	.17	100
Tetrachloroethane [1,1,2,2-]	79-34-5	1	.20	-
Tetrachloroethene	127-18-4	1	.20	5
Toluene	108-88-3	1	.17	1,000
Trichloroethane [1,1,1-]	71-55-6	1	.16	200
Trichloroethane [1,1,2-]	79-00-5	1	.32	5
Trichloroethene (TCE)	79-01-6	1	.16	5
Trichloropropane [1,2,3-]	96-18-4	1	.27	-
Vinyl chloride	75-01-4	1	.38	2
Xylenes [total]	1330-20-7	2	.19	10,000

[1]STL (2005).

[2]USEPA (2004).

Table FSP-8. Analytes include in Severn Trent Laboratory Method SW-846-8321A with solid-phase extraction for explosive compounds with laboratory reporting levels, method detection limits, and U.S. Environmental Protection Agency's health advisories.

[CAS, Chemical Abstract Service Number; STL, Severn Trent Laboratory, Denver, Colorado; LRL, laboratory reporting level; µg/L, micrograms per liter; MDL, method detection limit; USEPA, U.S. Environmental Protection Agency; HA, health advisory; --, no HA or 10-4 cancer risk available]

Analyte	CAS number	STL		USEPA HA	
		LRL (µg/L)[1]	MDL (µg/L)[1]	Lifetime HA[2] (µg/L)	10^{-4} cancer risk[2] (µg/L)
Nitroglycerin (trinitroglycerol)	55-63-0	0.12	0.042	5	200
PETN	78-11-5	.12	.038	--	--
2-Nitrotoluene (2-NT)	88-72-2	.12	.057	--	--
Nitrobenzene (NB)	98-95-3	.12	.036	--	
3-Nitrotoluene (3-NT)	99-08-1	.12	.064	--	--
1,3,5-Trinitrobenzene (1,3,5-TNB)	99-35-4	.12	.018	--	--
1,3-Dinitrobenzene (1,3-DNB)	99-65-0	.12	.019	1	--
4-Nitrotoluene (4-NT)	99-99-0	.12	.061	--	--
2,4,6-Trinitrotoluene (2,4,6-TNT)	118-96-7	.12	.026	2	100
2,4-Dinitrotoluene (2,4-DNT)	121-14-2	.12	.038	--	5
Cyclotrimethylene trinitramine (RDX)	121-82-4	.12	.013	2	30
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	355-72-78-2	.12	.017	-	--
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	.12	.017	--	--
2,6-Dinitrotoluene (2,6-DNT)	606-20-2	.12	.037	--	5
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	1946-51-0	.12	.022	--	--
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	.12	.017	400	--

[1]USEPA (1996c), Penfold (2001), and STL (2003).

[2]USEPA (2004).

Table FSP-9. Schedule for collection of quality-control samples.

[USGS, U.S. Geological Survey; NWQL, National Water Quality Laboratory, Denver, Colorado; VOCs, volatile organic compounds; STL, Severn Trent Laboratory, Denver, Colorado; SPE, solid-phase extraction]

Sampling period	Analytical laboratory	Analytical method	Analytes	Number of equipment blanks	Number of field blanks	Number of field replicates	Number of trip blanks	Number of matrix spike/matrix spike duplicates
Spring 2005	NWQL	USGS O-4127-96, Schedule 1380[1]	61 VOCs	1	2	One every 12 samples	One in cooler sent on first day.	None
	STL	SW-846-8321A with SPE[2]	Explosives	None	2	One every 12 samples	None	1 each
Fall 2005	STL	SW 846-8260B[3]	7 selected VOCs	None	2	One every 12 samples	One in cooler sent on first day.	1 each
		SW 846-8321A with SPE[2]	Explosives	None	2	One every 12 samples	None	1 each
Spring 2006	STL	SW 846 8260B[3]	7 selected VOCs	1	2	One every 12 samples	One in cooler sent on first day.	1 each
		SW 846-8321A with SPE[2]	Explosives	None	2	One every 12 samples	None	1 each
Fall 2006	STL	SW 846 8260B[3]	7 selected VOCs	None	2	One every 12 samples	One in cooler sent on first day.	1 each
		SW 846-8321A with SPE[2]	Explosives	None	2	One every 12 samples	None	1 each

[1]Connor and others (1998) and NWQL (2004).

[2]USEPA (1996c), Penfold (2001), and STL (2003).

[3]USEPA (1996b) and STL (2005).

FSP 5.3.1 Water-Level Measurements

Prior to sampling each well and during the sampling procedure, the sampling team will measure the depth to water to the nearest 0.01 ft in the well using an electric water-level indicator. Proper operation of the water-level indicator will be checked daily. A second water-level indicator will be brought in the field vehicle as a backup in case of instrument malfunction.

FSP 5.3.2 Measurement of Water Properties

The meters that will be used for water property measurements are a Thermo-Orion Model 124® for specific conductance and temperature, an Orion Model 250A+® for pH and temperature, a Hach Model 2100P® for turbidity, and a YSI Model 58® for DO or similar appropriate meters. The meters will be calibrated daily prior to sampling each well using the manufacture's instructions and appropriate reference solutions as described in the USGS Field Manual (USGS, 1997-2005).

Measurements of all physical properties will be obtained during purging of the observation well. To make the water property measurements, the discharge tubing from the Bennett sample® pump will be attached to a flow chamber, and the specific conductance, pH, and DO meters will be placed in openings in the flow chamber. Turbidity will be measured by filling a bottle from the flow chamber's discharge hose and inserting the bottle into the turbidimeter. Measurements are considered stable when three consecutive readings, made at 3-minute intervals, are within the limits specified in table FSP-10.

FSP 5.3.3 Other Measurement

Barometric pressure will be measured using a barometer. Project-derived wastewater will be screened with a ToxiRae® photoionzation detector (model PGM-30) or similar meter for evidence of VOC compounds.

Table FSP-10. Stabilization criteria for recording field measurements.

[±, plus or minus values shown; °C, degrees Celsius; ≤, less than or equal to value shown; %, percent; μS/cm, microsiemens per centimeter at 25°C; >, greater than value shown; unit, standard pH unit; mg/L, milligrams per liter; NTRU, nephelometric turbidity ratio unit]

Standard	Maximum variation[1]
Specific conductance:	
when ≤100 μS/cm	±5 %
when > 100 μS/cm	±3 %
pH:	
Meter displays to 0.01	±0.1 units
Temperature:	
Thermistor temperature	±0.2°C
Turbidity:	
Turbidimetric method, in NTRU	±10 %
Dissolved oxygen:	
Amperometric method	±0.3 mg/L

[1]USGS (1997-2005).

FSP 5.4 Sampling Methods for Ground Water

Ground-water sampling will be performed by two people; one person is called CH and the other person is called DH. CH/DH sampling techniques are described in the USGS Field Manual (USGS, 1997-2005). CH takes care of all operations involving equipment that contacts the sample; DH takes care of all operations involving contact with potential sources of contamination. Although specific tasks are assigned at the start to CH or DH, some tasks overlap and can be handled by either as long as the prescribed care is taken to prevent contaminating the sample. Both CH and DH wear appropriate disposable, powderless gloves during the entire sampling operation and change gloves frequently, usually with each change in task.

The sampling procedure is described below (USEPA, 1996a; Puls and Barcelona, 1996; USGS, 1997-2005):

1. Assemble the packers as they are being put into the well—the bottom packer, the screened interval between the packers, the top packer, the 2-in. diameter riser pipe with support structure for the attached safety line, and a sufficient number of 2.5 or 5-ft sections of riser pipe to extend to land surface (fig. FSP-4). All parts of the packer assemblage are decontaminated using steam or deionized water prior to lowering the unit into the well.
2. Lower the decontaminated packer assemblage into the well slowly until the screen between the packers is set at the appropriate depth for each sample. The shallow sample will be collected first, and the deep sample will be collected last.
3. Inflate the packers with air using a hand pump for bicycle tires, and check to ensure that the packers are inflated by trying to pull the packers up the well; if the packers are inflated, they will not move.
4. Lower the decontaminated pump to slightly above the top of the packer screen or within the screen between the packers. A Bennett sample® pump, or similar appropriate pump, will be used for purging and sampling. The Bennett sample® pump is a submersible piston pump that will be run by air pressure; the pump is equipped with tubing that extends from the pump intake to the sampling point.
5. Before starting the pump, measure the water level with the decontaminated water-level indicator.
6. Place the meters to measure water properties in the flow-through chamber.
7. Attach the pump's discharge hose to the flow-through chamber.
8. Start the pump at the slowest speed setting and slowly increase the speed until discharge occurs.
9. Measure the water properties every 5 minutes during purging.
10. Check the water level. Adjust the pump speed until the water-level drawdown is minimal relative to the length of the water column and that the water level is stable.
11. Continue pumping until three times the volume of water equivalent to the volume within the 2-in. riser pipe is pumped from the well and the water properties stabilize (table FSP-10).
12. Monitor and record the water level, packer inflation pressure, and photoionization reading of discharge water every 5 minutes during purging. Record water level, packer inflation pressure, and photoionization readings in the field notebook or on supplemental log sheets.
13. Measure the pumping rate using a bucket with volume markings and a stopwatch. Record pumping rate information, including pumping rate adjustments, on USGS ground-water-quality notes form (GWQN) (appendix B-1).
14. Record all water-property readings on GWQN (appendix B-1).
15. Pump well until water properties stabilize (table FSP-10).
16. Disconnect the pump discharge tubing from the flow-through chamber; attach the pump discharge tubing to the sampling chamber.
17. Select sampling time and write the date and time on each of the sample containers and the associated USGS analytical services request form (ASRs) (appendix B-2).

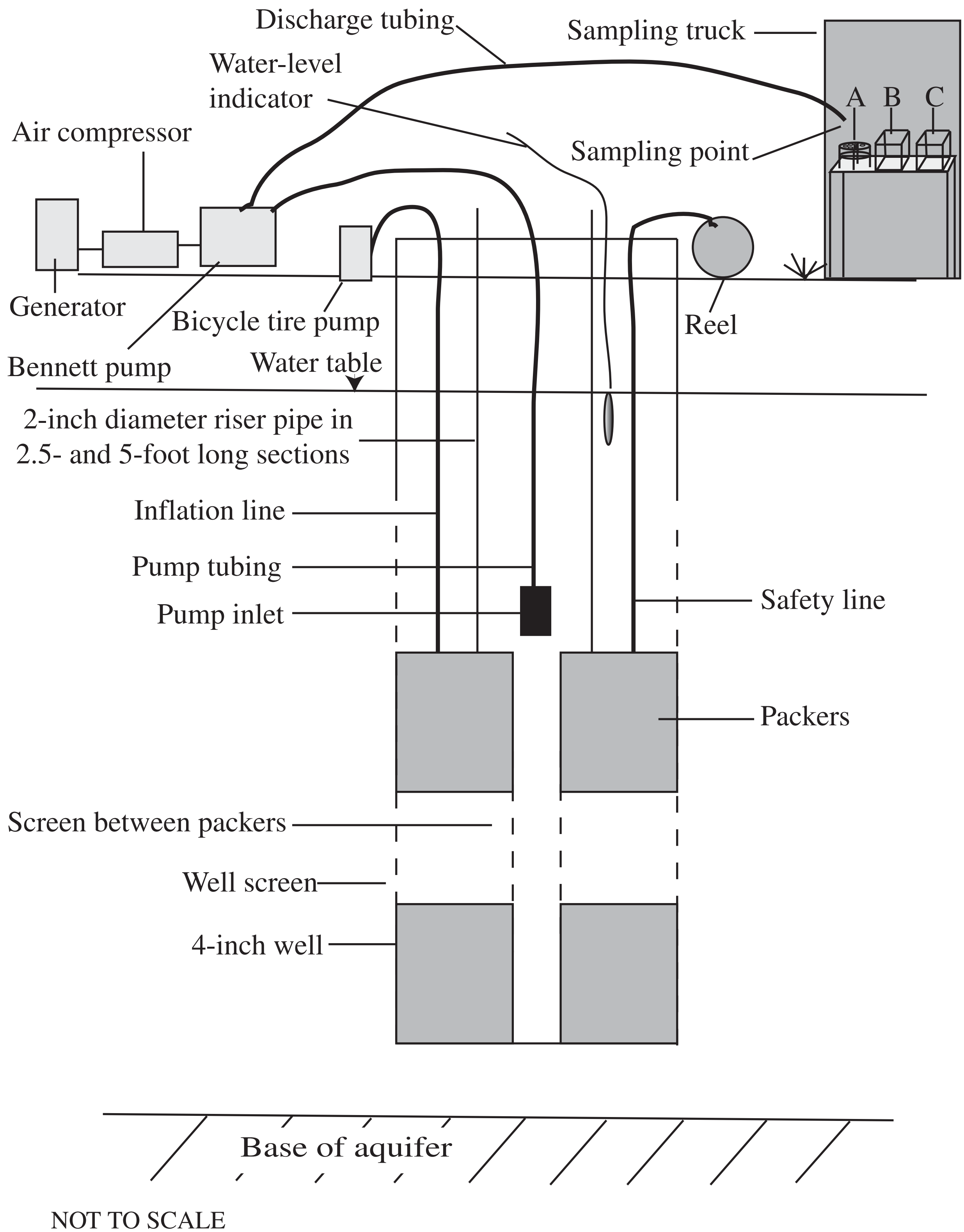


Figure FSP-4. Diagram showing observation well construction and proposed sampling equipment for project (A, flow-through chamber; B, sampling chamber; and C, preservation chamber).

18. Collect samples to be analyzed for VOCs directly from the pump discharge tubing without filtration. VOC collection procedures will vary depending on whether the analysis will be done by NWQL or STL. VOC samples to be sent to STL will be collected in pre-acidified bottles; VOC samples to be sent to NWQL will be acidified in the field.
    a. For VOC samples to be sent to NWQL, before collecting the environmental or QC samples, the amount of hydrochloric acid (HCL) required to lower the pH of the sample to less than 2 standard units is determined as follows: CH collects the a 40-mL vial in the sampling chamber by filling the vial from the discharge tubing; flow from the discharge tubing is adjusted so the water flows with minimal turbulence into the container. DH empties the 40-mL vial in a clean beaker with a calibrated pH probe; DH slowly adds HCL droplets to the beaker, mixing the beaker contents after adding each droplet until the pH of the beaker's contents is less than 2 standard units. DH notes the number of HCL droplets added on GWQN (appendix B-1) and ASR (appendix B-2).
    b. To collect the VOC environmental and QC samples sent to NWQL, CH collects three to four 40-mL vials for VOC analysis by inserting the discharge tubing into the bottom of each vial and slowly pulling the vial away from the tubing so the tubing is drawn up the side of the vial; a meniscus should form at the top of each vial. CH will carefully cap the vial and check for air bubbles. If there are air bubbles in the vial, the vial will be discarded, and the sample will be collected using the same procedures in another vial.
    c. To collect the VOC environmental and QC samples sent to STL, CH collects three to four 40-mL vials for VOC analysis by holding the top of the preacidified VOC vial at a slight angle to the discharge tubing and allowing the water to flow down the side of the bottle, slowly pulling the vial away from the tubing as meniscus forms at the top of the vial. CH will carefully cap the vial and check for air bubbles. If there are air bubbles in the vial, the vial will be discarded, and the sample will be collected using the same procedures in another vial.
    d. For VOC samples to be sent to NWQL, CH will place the sample vials in the acid preservation chamber and, for each sample vial, carefully remove the cap, add the required amount of HCL, recap the vial, and check the vial for air bubbles. If there are air bubbles in any of the sample vials, the vial will be discarded, and the sample will be recollected.
    e. VOC samples to be sent to NWQL and STL, DH places the three to four 40-mL vials in a foam sleeve and then into a sealable plastic bag; finally, the plastic bag with the samples is placed in a cooler with ice.
    f. If replicate, matrix spike, or matrix spike duplicate VOC samples are scheduled for the well at this depth, samples will be collected using the same procedures that were used for the environmental sample.
19. Collect samples to be analyzed for explosives directly from the pump discharge tubing without filtration.
    a. The explosive sample is collected in the sampling chamber by CH. Sample collection consists of filling two to three 1-L bottles to the shoulder and capping the bottles. DH places each bottle in a foam sleeve and then into a sealable plastic bag; finally, the plastic bags with the samples are placed in a cooler with ice.
    b. If replicate, matrix spike, or matrix spike duplicate samples to be analyzed for explosives are scheduled for this well at this depth, collect these samples using the same procedures that were used for the environmental sample.
20. Collect and record a final water-level measurement.
21. Remove the pump tubing from the well; decontaminate the pump and pump tubing by cycling tap water with a small amount of Liqui-Nox®, then tap water, and finally dionized water through the pump and pump tubing.
22. Deflate the packers and lower the packer assemblage down the well slowly until the screen between the packers is set at the appropriate depth for the deep sample.
23. Inflate the packers with air using a hand pump for bicycle tires, check to ensure the packers are inflated by trying to pull the packers up the well; if the packers are inflated, they will not move.
24. Lower the pump to slightly above the top of the packer screen or within the screen between the packers.
25. Repeat steps 4 through 19 to collect samples from the deeper interval.
26. Remove the pump tubing from the well, decontaminate the pump and pump tubing by cycling tap water with a small amount of Liqui-Nox®, then tap water, and finally dionized water through the pump and pump tubing. After cleaning the pump is covered with clean plastic bags.
27. Deflate the packers and remove the packer assemblage from the well.
28. Decontaminate the packers and riser pipe by inserting each part into standpipes with tap water and a small amount of Liqui-Nox®, rinsing the part with dionized water, inserting the part into standpipes with tap-rinse water, rinsing the part with dionized water, inserting the part into standpipes with dionized water, and finally

rinsing the part with dionized water or dionized-steam water. After cleaning, the packers and riser pipe are covered with clean plastic bags.

FSP 5.5 Sample Containers and Preservation Techniques

Samples will be containerized and preserved according to the analysis method's requirements (table FSP-11). VOC samples sent to STL will be in pre-acidified bottles; VOC samples sent to NWQL will be acidified in the field to less than 2 standard units. The VOC sample vials must be filled completely and chilled. The explosive samples should be filled to the shoulder of the bottle and the bottles must be chilled.

FSP 5.6 Field Quality-Control Sampling Procedures

QC samples include equipment blanks, field blanks, trip blanks, replicates, matrix spikes, and matrix spike duplicates and may include source solution blanks. The schedule for QC sample collection is presented in table FSP-9. The description of each type of QC sample:

- Equipment blanks will be collected at NWSC using the pump and the packers that will be used for sampling. Equipment blanks will be analyzed for VOC compounds and not for explosive compounds to establish whether VOC compounds used to clean the packer pipe during the manufacturing have been removed from the packer assemblage; equipment blanks will not be analyzed for explosive compounds because it is highly unlikely that the packers would leach explosive compounds. If VOC compounds from the NOP leach from the packers selected for the project, a different type of packers will be used to sample the wells.
- Field blanks are rinsate blanks that will use non-dedicated sampling equipment to assess decontamination procedures between sampling. The field blanks will be collected under field conditions; one field blank will be collected after a depth is sampled in the first well and the pump and pump tubing is decontaminated. The other field blank will be collected after a second well is sampled. The field blanks will be analyzed for VOC and explosive compounds.

Table FSP-11. Sample containers, preservatives, and holding times.

[USGS, U.S. Geological Survey; NWQL, National Water Quality Laboratory, Denver, Colorado; VOC, volatile organic compounds; mL, milliliters, HCL, hydrochloric acid; °C, degrees Celsius; USEPA, U.S. Environmental Protection Agency; STL, Severn Trent Laboratory, Denver, Colorado; SPE, solid-phase extraction; L, liter]

Method	Laboratory	Type of analysis	Matrix	Containers	Sample volume	Preservation	Holding time, starting from date of sample collection
USGS O-4127-96[1]	NWQL	61 VOCs	Water	Three to four 40-mL vials with Teflon®-lined septa; the fourth vial is not required but is supplied for NWQL's use if needed.	Fill so no headspace.	Sufficient HCL to reduce sample's pH to less than 2 standard units; chill sample and maintain at 4°C.	14 days to analysis.
USEPA SW 846-8321A with SPE[2]	STL	16 explosive compounds	Water	Two1-L amber glass bottles.	Fill to shoulder.	Chill sample and maintain at 4°C.	7 days to extraction; analyze within 40 days from extraction.
USEPA SW 846-8260B[3]	STL	7 of 21 VOC compounds	Water	Three to four 40-mL vials with Teflon®-lined septa.	Fill so no headspace.	Chill sample and maintain at 4°C (bottles are pre-acidified).	14 days to analysis.

[1]Connor and others (1998) and NWQL (2004).

[2]USEPA (1996c), Penfold (2001), and STL (2003).

[3]USEPA (1996b) and STL (2005).

- Trip blanks will be obtained from the laboratory doing the VOC analysis. Trip blanks will be put in the first cooler of VOC samples sent to the laboratory each sampling period.
- Replicates, matrix spikes, and matrix spike duplicate samples will be collected using the same procedures as the environmental samples. Replicates will be analyzed for VOC and explosive compounds; the matrix spikes and matrix spike duplicates will be collected for VOC and explosive compounds only for samples to be sent to STL.

QA samples (that is, samples analyzed by the regulating agency) will not be collected for this project.

Equipment blanks will be collected and the results reviewed before the spring 2005 and spring 2006 samplings. The equipment blanks will be collected in the sample chamber by filling a standpipe with VOC-free blank water, lowering the packer assemblage into the standpipe, inflating the packers in the standpipe, lowering the pump tubing to just above or within the packer's screened interval, and filling the sample bottles. CH will fill three to four 40-mL vials completely, carefully cap the vials, and ensure that there are no air bubbles in the vials. If an air bubble is present in one or more of the vials, those vials will be discarded, and new vials will be filled. If the samples will be sent to NWQL, CH will add two drops of HCL to each of the equipment-blank sample vials; the samples to be sent to STL will be in pre-acidified vials.

Replicates, matrix spikes, and matrix spike duplicates will be collected after the associated environmental sample. A trip blank will be ordered from the laboratory prior to each sampling period, placed in the cooler before the sampling, and sent to the laboratory for analysis with the samples.

Field blanks will be collected during each sampling period. Field blanks will be colleced by filling a standpipe with VOC-free blank water, lowering the packer assemblage into the standpipe, lowering the pump tubing to just above the packer's screened interval, and filling the sample bottles. CH will fill three to four 40-mL vials completely, carefully cap the vials, and ensure that there are no air bubbles in the vials. If an air bubble is present in one or more of the vials, those vials will be discarded, and new vials will be filled. If the samples will be sent to NWQL, CH will add two drops of HCL to each of the field-blank sample vials; the samples to be sent to STL will be in pre-acidified vials.

FSP 5.7 Decontamination Procedures

Decontamination of equipment and personnel will be performed to protect the health and safety of the sampling team and the public and to avoid contamination or cross-contamination of samples. Decontamination will be done at each well in an area that is upwind of any exhaust sources. Decontamination of the water-level indicator probe and cable will be performed by spraying distilled water over the probe and cable and drying them with a paper towel. This procedure will be repeated before and after collection of water-level measurements at each well. Decontamination of the inside of the pump tubing will be performed by cycling a dilute Liqui-Nox® solution through the tubing, rinsing with tap water, and finally rinsing with distilled water. Decontamination of the outside of the pump tubing and the packer assemblage will be performed by spraying the equipment with distilled water.

FSP 6.0 Field Operations Documentation

The Project Chief will be responsible for ensuring the current FSP is available to the sampling team during sampling. Field documentation includes field notebooks, photographs, and the following standard forms—GWQN (appendix B-1), ASR form (appendix B-2), and the appropriate COC form (appendix B-3 or B-4).

FSP 6.1 Daily Chemical Quality-Control Reports

During the samplings, the daily chemical quality control report (DCQCR) will be prepared, dated, and signed by the Project Chief or a designee. DCQCR will include the following information:

- Summary of work done during the day and
- Problems that occurred during the day and any deviations in the sampling procedures that may affect data-quality objectives.

FSP 6.2 Field Notebook

The field notebook will be a hardbound book and supplemental log sheets of water-resistant paper; entries in the notebook and supplemental log sheets will be written using indelible ink. The top of each page will have the project name and number, date, and page number. Each entry in the book will have the time, initials of person making the entry, if this person is other than the day's primary recorder, and sufficient detail so that the logic used in decisionmaking during the project can be traced later in a review.

At the start of the first day of each ground-water sampling, the following information will be recorded in the field notebook or supplemental log sheets:

- Name and task-related title of each of the field sampling team members;
- Purpose of the field activity;
- Name and address of field contacts;
- References for map of the wells to be sampled;
- Planned chronology of events during the sampling, including sample-collection methods, and any planned deviations to the approved sampling plans;
- Information concerning any property access agreements; and

- Name and title of any MUD or regulator representative scheduled to be present during sampling.

During sampling, the following information will be added to the field notebook or supplemental log sheets:

- Weather conditions, air temperature, wind speed and direction, and weather forecast for the day;
- General field observations;
- Information about any conversations with property owners or members of the public; and
- Chronology for the day that is filled out as the day progresses, detailing the activities at each well to be sampled, including:
  - Water-level measurements at each well;
  - Decontamination procedures;
  - Number and volume of samples collected;
  - Date and time of sample collection;
  - Sample identification number(s);
  - Sample documentation, such as bottle lot numbers as received from supplier;
  - Sample transportation information, including the name of the laboratory and courier; and
  - Information on any deviations from the approved work plans, including sampling methodology and sample preservation.

At the end of daily activities, the primary recorder for the day will note the end of the day's log by drawing a diagonal line over unused lines, writing the time, and signing his or her name at the bottom of the last page for that day.

After sampling, the Project Chief will ensure the following information is recorded in the field notebook:

- Summary of daily tasks and documentation on any scope of work changes required by field conditions, and
- Signature and date for each entry by personnel responsible for observations.

FSP 6.3 Photographic Records

Photographs will be taken to document changes in the conditions of the wells and any circumstances where a photograph is considered necessary documentation. A photographic log will be kept in the field notebook to identify the location and subject of each photograph. The photographer will review the photographs and compare them to the photographic log to confirm the log and photographs match.

FSP 6.4 Sample Documentation

The documentation records for each sample include the sample label, GWQN (appendix B-1) and ASR (appendix B-2). The documentation records for the samples in each cooler sent to NWQL and STL will include the laboratory's COC form (appendix B-3 and B-4), a stamped envelope addressed to the Project Chief (NWQL only), and electronic messages (E-mails) between the Project Chief and the laboratories.

Laboratory personnel will note the condition of the cooler and the temperature of the cooler's interior when the cooler is opened in the log-in area. Laboratory personnel will notify the Project Chief by telephone or E-mail that samples were received and if there were any problems with the condition of the cooler or samples. NWQL personnel also will note the condition of the cooler and the temperature of the cooler's interior on the COC form; STL personnel will note the condition of the cooler and the temperature of the cooler's interior STL's condition on Condition Upon Receipt (CUR) form (appendix B-5). The COC and CUR forms will be returned to the Project Chief either in the stamped envelope (NQWL) or with the analysis results (STL).

FSP 6.4.1 Sample Numbering System

The sample identification codes for environmental and QC samples, with two exceptions, are constructed so that personnel in NWQL or STL cannot identify whether the sample is an environmental or QC sample from the sample identification code. The two exceptions are the matrix spike and matrix spike duplicate samples to STL, STL personnel must know the samples are matrix spike and matrix spike duplicates prior to analysis because these types of samples require separate treatment during analysis. The sample identification code for environmental samples sent to NWQL and STL will consist of:

1. A 15-digit site number, formed by the latitude and longitude of the well, and a two digit number typically equal to "01"; however, if the well is one of a nest of wells, one well in the nest is assigned "01" another "02," and so on, depending on the number of wells;
2. The date and time the sample was collected, rounded to the nearest 10-minute interval;
3. Medium code equal to "6"; and
4. Sample type equal to "9".

For example, for the environmental sample from well M90-10 collected at the shallow depth on May 20, 2005, at 10:00 a.m., the sample identification code is site number as assigned, date 20050520, time 1000, medium 6, and sample type 9.

The sample identification code for QC samples sent to NWQL and STL will consist of:

1. The 15-digit site number for the related well;
2. The date the sample was collected;
3. The time the environmental sample was collected plus a specified number of minutes, depending on the type of QA/QC sample, for example:
   a. 1 minute for the equipment blank,
   b. 2 minutes for the field blank,

c. 3 minutes for the trip blank,

d. 4 minutes for a QA sample (if any are collected),

e. 5 minutes for a source solution blank (not required by the project),

f. 7 minutes for the replicate,

g. (STL only) 0 minutes for the matix spike on the label, ASR, and COC to STL and 8 minutes for the matrix spike results in NWIS, and

h. (STL only) 0 minutes for the matrix spike duplicate on the label, ASR, and COC to STL and 9 minutes for the matrix spike duplicate results in NWIS.

4. Medium code equal to “6”; and
5. Sample type equal to “9”.

For example, for a replicate sample from well M90-10 collected at the shallow depth on May 20, 2005, at 10:00 a.m., the sample identification code for the laboratories is site number as assigned, date 20050520, time 1007, medium 6, and sample type 9. The sample’s sample type code will be changed from 9 to 7 after the Project Chief receives the analysis results. For the matrix spike and matrix spike duplicate, the words “matrix spike” and “matrix spike duplicate” will be written on the sample label, ASR, and COC.

The sample identification code will be printed or written on the ASRs (appendix B-2) for all the sample bottles, including environmental and QC bottles, and will be referenced in this report as the “sample identification code sent to the laboratory”. The correct medium and sample type codes will be referenced in this report as the “sample identification code for NWIS”. The correct USGS medium codes are “6” for ground water, “S” for replicate and spikes, and “Q” for artificial mediums, which includes all types of blanks; the correct USGS sample types are “1” for spike, “2” for blank, “7” for replicates and regular samples associated with a replicate, and “9” for a regular sample not associated with a replicate.

When environmental samples are logged into USGS NWIS database, NWIS parameter code 72015 will be populated with the depth to the top of the sampling interval in feet below land surface and parameter code 72016 will be populated with the depth to the bottom of the sampling interval in feet below land surface. If an environmental sample is associated with a replicate, the sample type will be changed from “9” to “7”.

When the QC samples are logged into NWIS database, the person logging in the samples will enter the correct sample medium and sample type. In addition, for all QC samples except equipment blanks, field, and trip blanks, the person logging in the samples will populate NWIS parameter code 72015 with the depth to the top of the sampling interval in feet below land surface and NWIS parameter code 72016 with the depth to the bottom of the sampling interval in feet below land surface. When the equipment, field, and trip blanks are logged into the NWIS database, NWIS parameters codes 72015 and 72016 will not be populated.

When the analysis results for environmental and QC samples are available from NWQL, the Project Chief will ask NWQL to change the medium and sample types in NWQL’s Laboratory Information System (LIMS) to the proper codes. When analysis results are received from STL, no action is required to adjust STL’s internal LIMS records since STL assigns their own sample number to each sample; however, a note will be added by the Project Chief to the field notebook providing a cross reference between STL’s sample number and the correct sample and medium types for each sample. When the digital analysis results files to update NWIS are received from STL, the correct sample type and medium code will be entered in each record before updating NWIS.

FSP 6.4.2 Sample Labels

The sampling team will preprint sample labels for each sample bottle on waterproof labels. The labels will include the following information:

- USGS;
- Well’s short name assigned by MUD;
- Well’s USGS site identification code;
- Date and time collected, including time offset, if applicable;
- Chemical analysis to be performed, as the USGS Schedule number 1380 (Connor and others, 1998), USEPA Method SW 846-8260B (USEPA, 1996b; STL, 2005), or USEPA Method SW 846-SW-846-8321A with SPE (USEPA, 1996c; Penfold, 2001; STL, 2003) for explosives,
- Analytical laboratory (NWQL or STL);
- Bottle type code;
- Sample bottle size (1 L or 40-mL);
- Sample processing—filtered or nonfiltered, preservation method, and sample kept chilled or not chilled; and
- For matrix spike and matrix spike duplicates, the words “matrix spike” and “matrix spike duplicates.”

A permanent marker will be used to fill in the blanks on the sample labels.

FSP 6.4.3 Chain-of-Custody Records

Ground-water samples will remain in the possession of the sampling team until they are transferred to the shipper. If the samples are kept overnight, they will be stored in the locked laboratory vehicle until they are relinquished to the shipper. The following information will be recorded in the field notebook for each cooler:

- Shipper name,
- Laboratory name and address, and
- Date and time of shipment.

A NWQL COC form (appendix B-3) is required for coolers that are sent to NWQL; a STL COC form (appendix B-4) is required for coolers shipped to STL. COC forms will be kept by the Project Chief in the project folder.

FSP 6.4.4 Analytical Services Request Forms

The samples' ASRs (appendix B-2) will be filled out in the field with the following information when the associated sample is collected:

- USGS site identification code;
- Telephone number and E-mails at which field personnel who collected the samples can be reached;
- Name of Project Chief;
- State and Science Center user codes;
- Project account number;
- Date and time sample collected with the time offset, if applicable;
- Schedules and laboratory codes of the analytical work requested for submitted samples;
- Sample medium equal to "6";
- Sample type equal to "9" (the Project Chief will change the sample type as appropriate after analysis results are received from the laboratories);
- Analysis status as "H";
- Analysis source as "G" for samples to be sent to STL, "9" for samples to be sent to NWQL, and "5" for samples to be sent to NWQL and STL;
- Hydrologic condition as "X";
- Hydrologic event code as "X";
- Field-measurement values of specific conductance (conductivity) and pH at the bottom of the ASR (appendix B-2) for environmental samples and replicate samples, if properties were measured again for the replicate;
- In the comments section of the ASR (appendix B-2), information that needs to be brought to the laboratory's attention, such as "preserved with HCL to pH < 2";
- Type of bottle; and
- Total number of sample bottles for each schedule or method.

To prevent water damage to paperwork accompanying samples to the laboratory (such as the ASR forms (appendix B-2)), all paperwork will be placed inside plastic bags. In coolers, the bags containing the paperwork will be taped to the underside of the lid. The sampling team will keep a copy of the completed ASRs (appendix B-2) in the project's files after updating with the proper sample medium and sample type codes.

FSP 6.5 Field Analytical Records

The sampling team will fill out a GWQN (appendix B-1) for each depth interval sampled in a well, with a list of the analytical data collected during sampling. On GWQN form (appendix B-1), the sampling team will record the following information:

- Field measurement data, including static water level, depth below land surface to the top and bottom of the sampling interval, flow rate, pumping period, specific conductance, pH, water temperature, turbidity, dissolved oxygen, barometric pressure, and the reading from the photoionzation detector or similar meter;
- Sampling information, including type of pump, sampling material, ground-water color, clarity, and odor, and weather conditions;
- Well data, including casing volume, volume pumped before sampling, and pumping water level during sampling;
- Methods and equipment selected, including calibration information for the specific conductance, pH, water temperature, turbidity, and dissolved oxygen probes;
- Log of water property readings during well purging until stabilization is achieved;
- Sample preservation procedures, including the HCL lot numbers; and
- For QC blank samples, the manufacturer's lot numbers of the blank water.

FSP 6.6 Documentation Procedures/Data Management and Retention

FSP 6.6.1 Documentation Procedures

The sample documentation procedures will include filling out all paperwork at the wells during the ground-water sampling. The Project Chief will be responsible for reviewing the information contained in GWQN (appendix B-1) and field notebook. The Project Chief also will be responsible for:

- Maintaining the project file,
- Contacting NWQL and STL, and
- Contacting equipment and other suppliers.

The sampling team will be responsible for the following activities:

- Filling out the sample labels, GWQNs (appendix B-1), and ASRs (appendix B-2);
- As required, making entries in the field notebook;
- Preparing the appropriate COC form (appendix B-3 or B-4); and
- Packing the samples and delivering them to the shipper.

The sampling team will enter the information from GWQN (appendix B-1) and ASRs (appendix B-2) with the correct medium and sample type codes into USGS NWIS database to create the record to store the sample's analytical results and field-measured properties. The sampling team will enter the field-measured properties for each sample.

Laboratory personnel will fill out COC (appendix B-3 or B-4) for each cooler they receive and return the COC forms to the Project Chief in the stamped self-addressed envelope that were provided with the COC forms (NWQL) or with analysis results (STL).

FSP 6.6.2 Corrections to Documentation

All original data recorded in the field notebooks and on sample labels, GWQN (appendix B-1), ASRs (appendix B-2), and the appropriate COC forms (appendix B-3 or B-4) will be written in waterproof, nonerasable ink. If an error is made on these documents, corrections will be made by crossing out the error with one line and entering the correct information. The erroneous information will not be obliterated. Any error discovered in a document, if possible, will be corrected by the person who made the entry. All corrections will be initialed and dated.

FSP 6.6.3 Documentation Archive

The project's file folder will be maintained in the NWSC's general storage area for 10 years. After 10 years, the project's file folder will be sent to the National Archives and Records Administration repository.

FSP 6.6.4 Data Management and Retention

The analysis results data from NWQL and STL will be stored in USGS NWIS database. USGS NWIS database will be backed up and maintained indefinitely.

FSP 7.0 Sample Packaging and Shipping Requirements

The following procedures are to be used for packaging and shipping the environmental and QC samples after the samples are collected in appropriate containers and correctly preserved.

FSP 7.1 Sample Packaging

The sample to be analyzed for VOCs (for example, the sample for MW94-5 shallow) will consist of three to four 40-mL vials. The VOC vials for each sampling point will be placed in a foam sleeve and then into one plastic bag and that plastic bag will be placed in another plastic bag to make the "VOC-sample" package. The VOC-sample package will be packed in a cooler with ice until the VOC-sample packages are packed for shipping. If the cooler will have a trip blank, the associated vials will be packed in a separate plastic bag and placed in the cooler.

The sample to be analyzed for explosives will consist of two to three 1-L bottles; one to two extra 1 L of sample is collected for each sampling point to provide extra water to the laboratory in the event there is breakage during shipping or there is a problem with the analysis in the laboratory. Each 1-L bottle will be placed in a bubble sleeve and then in a plastic bag. All bottles, which are the "explosives-sample" package for the sampling point, will be placed together in a larger plastic bag; the bag will be sealed and submerged in an ice bath until the explosives-sample packages are packed for shipping.

The sampling team will fill out and sign each cooler's ASR (appendix B-2) and COC (appendix B-3 or B-4) forms. For each cooler, a sampling team member will compare ASR (appendix B-2) and the appropriate COC form (appendix B-3 or B-4) with each sample's label to ensure the forms accurately reflect the cooler's contents and that the correct samples are in the cooler. Any disagreement in information will be resolved.

Packing for shipping begins with removing labels, and other marks from previous shipments from the coolers that will be used as the shipping container and then wiping the inside of the cooler with a paper towel. An insulating blanket will be placed on the bottom of the cooler to cushion the samples. Two large plastic garbage bags will be used as a liner for the cooler.

Ice will be double bagged and placed around the samples. The VOC- and explosives-sample packages will be placed in the cooler so that they do not touch each other during shipment. Packing material, such as bubble wrap, will be placed between the packages. The plastic-liner bags will each be tied shut. The following forms will be placed in a plastic bag and taped to the inside lid of the cooler: ASR (appendix B-2), the appropriate COC form (appendix B-3 or B-4), stamped envelope for returning the COC form to the Project Chief (NWQL only), and label for shipping the cooler back to NWSC (NWQL only). Then, the cooler will be closed and taped shut with filament-type strapping tape.

After the shipping containers are packed and sealed with tape, a minimum of one 6-in. strip (or longer) of pre-printed COC tape will be placed vertically over the lid of the closed coolers. The COC tape must be overlain with clear shipping tape so that the COC tape will not be accidentally damaged in transit.

FSP 7.2 Sample Shipping

Sampling will generally be scheduled for Monday through Thursday, so that the laboratories have at least 4 workdays before the end of the sample's hold time. Sampling will not be scheduled on Federal holidays or on the Friday before a Federal holiday.

The sampling team will (1) prepare the coolers for shipment by attaching the Federal Express airbill to a Federal Express shipping tag that will be attached to the cooler handle and (2) deliver the coolers to the Federal Express office in Lincoln, Nebraska, or Omaha, Nebraska. The Federal Express

airbills will have the analytical laboratories' address (table FSP-12), contact person, and phone number, USGS NWSC's address, name and phone number, and USGS project number for internal billing purposes. The type of delivery service required from Federal Express will be marked on the airbill (priority-overnight delivery and, for shipments on Friday, the airbill will be marked for Saturday delivery).

FSP 8.0 Project-Derived Waste

Project-derived waste from ground-water sampling will be managed according to the type of waste (table FSP-13). If the photoionization detector or laboratory results indicate evidence of ground-water contamination of TCE, RDX, dichloropropane [1,2-], or methylene chloride at the observation wells, the management of project-derived waste will be reevaluated.

FSP 9.0 Field Assessment/Three-Phase Inspection Procedures

FSP 9.1 Quality Control

The Project Chief is the primary QA Officer for the preparatory, initial, and follow-up phases of the project. The tasks subject to inspection are collecting the samples for each sampling. In the event the Project Chief is unable to conduct the inspections, NWSC Water Quality-Specialist or another appropriate person will act as QA Officer.

FSP 9.2 Sampling Apparatus and Field Instrumentation Checklist

Prior to collecting the field equipment blank(s) and other samples for each sampling, the Project Chief will ensure (1) the sampling team has reviewed SAP and understands the sampling procedures and (2) the required sampling equipment, field instruments, supplies, and reference materials are available for sampling (table FSP-14).

During sampling, the Project Chief will monitor equipment calibrations and inspect the field notebook to ensure all pertinent data have been recorded and the sample labels and STL COC forms to ensure they are accurate, complete, and consistent. The Project Chief also will oversee packaging and shipping of the samples. At the end of each day of sampling, the Project Chief or a designate will note the environmental and QC samples collected or shipped in DCQCR. Periodically, the Project Chief will perform a follow-up review of field data and calibration data for field instruments.

FSP 10.0 Nonconformance/Corrective Actions

If USGS or STL personnel discover a nonconformance with this SAP or other problems, the situation and resolution to the situation will be noted in the project's field notebook. Possible discrepancies or problems could include, but are not limited to, improper sampling procedures, improper instrument calibration procedures, incomplete or improper sample preservation, and problems with samples upon receipt at the appropriate laboratory.

The Project Chief will be responsible for implementation of FSP procedures. In the event of any improper sampling procedures, the Project Chief will (1) ask the sampling crew to immediately comply with FSP, (2) document the discrepancy from proper sampling procedures and the reasons for the discrepancy, and (3) re-collect the sample, if necessary, using the proper sampling procedures.

Instruments will be calibrated using established stabilization criteria (table FSP-10). The instrument calibration logbook will be assembled daily by the Project Chief. Any instrument problems will be reported immediately to the Project Chief, who will arrange to replace defective instruments with instruments in proper working condition. Improper instrument calibration and any corrective action will be documented in the logbook and reported in DCQCR.

Sample preservation procedures in the field will be supervised by the Project Chief or a designee. Sampling containers that have been prepared by the laboratories will be inspected by the Project Chief. In the event of sample container breakage or leakage or an air bubble in a VOC sample container, the sample container will be discarded, a new sample container and label will be provided by the Project Chief, and a new sample will be collected. The Project Chief or designee will document the circumstances that occur from sample collection to shipping in the project's field notebook.

The laboratories will relay problems with the samples to the Project Chief. In the event of discrepancies between COC form (appendix B-3 or B-4) and the sample labels, the Project Chief will resolve the problem. Broken sample containers or samples that are listed on COC forms and are not in the cooler will be replaced, if necessary, by the sampling crew following ground-water sampling procedures described in section FSP 5.3. The Project Chief will attach documentation of corrective actions on the original GWQN (appendix B-1), DCQCR, or the project's field notebook.

Any other deviation from FSP will be reported initially to the Project Chief, who will report the details in DCQCR to USGS NWSC's Water-Quality Specialist and to MUD.

Table FSP-12. Analytical laboratories.

[VOCs, volatile organic compounds; NWQL, National Water Quality Laboratory; STL, Severn Trent Laboratory; USGS, U.S. Geological Survey]

Type of analysis	Analytical laboratory	Address	Phone number	Contact person's name, phone number, and E-mail address
VOCs	NWQL	P.O. Box 25608, MS 407 Building 95, Entrance E3 Denver Federal Center Denver, Colorado 80225-0608	Phone: (303) 236-3707 Fax: (303) 236-3499	Phil Grano, (303) 236-3707, E-mail: pwgrano@usgs.gov; Will Lanier (303) 236-3710, E-mail: wdlanier@usgs.gov
VOCs and explosives	STL	4955 Yarrow Street Arvada, Colorado 80002	Phone: 303-736-0100 Fax: 303-431-7171	Wayne Scott, USGS Project Manager, 303-736-0193, E-mail: wscott@stl-inc.com

Table FSP-13. Planned management of project-derived wastes.

[NWSC, U.S. Geological Survey Water Science Center, Lincoln, Nebraska; PPE, personal protective equipment]

Type of project-derived wastes	Activity that generates the waste	Planned waste management	Rationale for planned waste management
Purge fluids	Purging well prior to sampling	Discharge to the ground surface, away from the well heads and any surface-water drainage.	Discharge water will be screened with photo-ionization detector. Because contaminants have not been detected or are detected at very low levels in wells upgradient from these wells, it is expected that contaminant levels will be low or undetectable in the ground water from these wells.
Any solid waste generated during sample collection such as PPE (for example, nitrile gloves), disposable material (for example, plastic bags), shipping boxes, and office waste.	Sample collection Office waste	Bring back to NWSC and place in office dumpster for disposal at a municipal landfill.	Because low, if any, contaminant concentrations in the ground water at these sites are expected, low, if any, contaminant concentrations on PPE, other disposable material, and shipping boxes are expected. Typical office waste is not contaminated.
Decontamination fluids	Decontaminating sampling equipment	Decontamination fluids will be discharged on the ground surface, away from the well heads and any surface drainage.	Because low, if any, contaminant concentrations in the ground water at these sites is expected, low, if any, contaminant concentrations in the decontamination fluids are expected.

Table FSP-14. Checklist for sampling equipment, field instruments, supplies, and reference material.

[gal, gallon; PVC, polyvinyl chloride; ft, foot; in., inch; HIF, U.S. Geological Survey Hydrologic Instrumentation Facility; DO, dissolved oxygen; mL, milliliter; VOC, volatile organic compounds; L, liter; oz, ounce; qt, quart; N_2, Nitrogen gas; DI, deionized; HCL, hydrochloric acid; GPS, global positioning system; FedEx, Federal Express; NWQL, National Water Quality Laboratory, Denver, Colorado; GWQN, ground-water quality notes form; ASR, analytical service request form; COC, chain-of-custody form; MSDS, Material Safety Data Sheets; USGS, U.S. Geological Survey]

Description
Sampling Equipment—general setup
Well keys
Two electric tapes (water level)
Steel tape
Garden hoses
Tools - pipe wrenches, screw driver, an so forth
Sampling Equipment—associated with the pump
Bennett sample® pump—air-operated submersible piston pump with variable flow rate
Reel and tube bundles for pump
Air compressor and associated tubing
Gas-powered generator
Gasoline
Bucket, with volume marks, 5-gal
Sampling Equipment—associated with the packers
Solinst packers, including screen section, inflation tubing, o-rings, and fittings
Bicycle tire pump to inflate packers
Winch and holder to support packers
Cable or rope to hold packers
PVC pipe, an appropriate number of 2.5- and 5-ft long sections of 2-in. diameter flush-threaded pipe with o-rings, to extend from the deep sample interval to land surface
Sampling Equipment—associated with collecting the sample from the discharge tube
Garden hose connection (connects Teflon tubing to “tufflite” adapter)
Anti-backsiphon valve
Teflon sample-extension lines
Flow manifold
HIF flow-through chamber
Flow-through chamber connection (connects manifold to chamber)
Sample-collection chamber
Preservation chamber
Miscellaneous plumbing equipment
Power inverter

Description
Health and Safety Equipment
Steel-toed boots
Nitrile gloves, sizes vary by sampling team
Safety glasses
First-aid kit
Photoionization detector and related supplies
Field Instruments
Conductance meter
pH meter
Barometer
Turbidity meter
DO meter
Bottle Collection Supplies
“Tufflite” garden hose adapter
Hose Y-splitter
Glass amber 40-mL vials (for VOC samples)
Glass amber 1-L: bottles with cone caps; pre-rinsed (for explosives samples)
Processing chamber bag
Sleeves, foam (large 1 L)
Sleeves, foam (small 4 oz)
Ziploc bags; 1-qt, 1-gal, and 2-gal sizes
Spare bottles
Labels for sample bottles
Meter Supplies
Spare pH probe
pH probe storage solution
Buffer solution-7 (check expiration date)
Buffer solution-10 (check expiration date)
Conductivity standards (check expiration date)
Paper laboratory wipes
Turbidity calibration standards (gel and liquid) and collection vials
Beakers for calibration

Table FSP-14. Checklist for sampling equipment, field instruments, supplies, and reference material.—Continued

[gal, gallon; PVC, polyvinyl chloride; ft, foot; in., inch; HIF, U.S. Geological Survey Hydrologic Instrumentation Facility; DO, dissolved oxygen; mL, milliliter; VOC, volatile organic compounds; L, liter; oz, ounce; qt, quart; N_2, Nitrogen gas; DI, deionized; HCL, hydrochloric acid; GPS, global positioning system; FedEx, Federal Express; NWQL, National Water Quality Laboratory, Denver, Colorado; GWQN, ground-water quality notes form; ASR, analytical service request form; COC, chain-of-custody form; MSDS, Material Safety Data Sheets; USGS, U.S. Geological Survey]

Description
Water Supplies
Organic free blank water, VOC grade, N_2 purged (gallon)
DI water
Tap water
Preservatives Supplies
HCL, 30-mL dropper bottle
Ice
Cleaning Supplies
Detergent, Liqui-Nox®
Large brush
Small brush
Silicon tubing and scissors
Aluminum foil
Plastic tubs for washing
Decontamination Equipment
High-pressure steam cleaner
PVC standpipes for cleaning packer parts, PVC tubing, pump, and pump tubing
4-in. diameter by 5-ft long (soap-tap, rinse-tap) schedule 40 PVC with o-ring caps
4-in, diameter by 5-ft long (organic, final DI) schedule 40 PVC with o-ring caps
Plastic bags
Miscellaneous Supplies
Electrical extension cords
Sharpie, pens, pencils
Calculator
Duct and electrical tape
Batteries; AA, 9-volt, DD sizes
Miscellaneous Supplies—Continued
Paper towels
Clipboard
Teflon tape
Stop watch
Cell phone and charger
Digital camera and accessories
Garmin® global positioning system (GPS 76 or a similar device)
Shipping Supplies
Scissors
Shipping tape
FedEx Air Bills and handle tags
Coolers
Return stamped envelopes for NWQL to return COC forms to Project Chief
Return address labels for coolers to NWQL
Laboratory addresses for reference
Large garbage bags
Reference Materials
Field notebook and supplemental log sheets
GWQN forms (appendix B-1)
ASRs (appendix B-2)
COC forms (appendix B-3 and/or B-4)
FedEx drop-off site locations and times
Road and Site maps (1:24,000-scale topographic map) and directions to sites
MSDS sheets
USGS National Field Manual
Meter manuals

Part II—Quality-Assurance Project Plan

The QAPP describes DQOs, analytical methods and measurements, QA and QC protocols necessary to achieve DQOs, and data assessment procedures for the evaluation and identification of any data limitations.

QAPP 1.0 Project Laboratory Organizations and Responsibilities

Chemical analysis will be done in compliance with guidance by the ANSI/ASQC (ANSI/ASQC, 1995), USEPA (USEPA, 2001a), and USACE (USACE, 1997, 2001). Water samples, which will be analyzed for 61 VOCs analytes, will be sent to NWQL in Denver, Colorado (fig. QAPP-1). The analyses for seven VOC compounds and explosives will be done by STL in Denver, Colorado (fig. QAPP-2).

QAPP 2.0 Data-Assessment Organization and Responsibilities

The individuals who will be performing data-assessment activities are:

- Kevin Tobin, MUD, represents MUD and is the primary contact with USGS, USACE, and LPNNRD.
- John Miyoshi, General Manager of LPNNRD, is a primary decisionmaker for the LPNNRD.
- Rodney Schwartz, USACE, Omaha District, is a primary decisionmaker for the project and a primary user of the data to determine whether further action is required in the area.
- Jennifer Ousley, USEPA, is a primary decisionmaker for the project and a primary user of the data to determine whether further action is required in the area.
- Virginia McGuire, USGS, NWSC, as Project Chief, will coordinate project activities. Her responsibilities include:
    - Completing FSP and QAPP,
    - Distributing the approved FSP and QAPP,
    - Coordinating field and laboratory activities,
    - Selecting and supervising the field sampling team,
    - Conducting the project activities in accordance with FSP and QAPP, verifying and validating the field and analytical data, and
    - Reporting project results to USEPA, MUD, USACE, Omaha District, USACE, Kansas City District, and LPNNRD.
- Thomas J. Maloney, NWQL, Chief of the Quality Assurance Section (QAS).
- Wayne Scott, STL Denver, Colorado, Project Manager and USGS's primary point of contact with STL.
- Richard Daddow, USGS Contracting Officer's representative (COR) for USGS contract with STL.
- Jill Frankforter, USGS NWSC, Water-Quality Specialist.
- Tim Boyle, USGS NWSC, Safety Officer.

QAPP 3.0 Data-Quality Objectives

To contribute to the institutional knowledge of the project area and to document the decisions made by the project team during the planning of the sampling and analysis of the monitoring wells near the MUD Platte River West Well Field, project-specific DQOs have been developed. DQOs are qualitative and quantitative statements that clarify project objectives, define the type of data, and specify the acceptable levels of potential decision errors that will be used to establish the quality and quantity of data required to support the decisionmaking process (USEPA, 2000, 2002). The purpose of DQOs is to provide formal documentation of the data-quality requirements (USACE, 1998) that will effectively provide data of a known quality and establish the benchmark to determine if the data meets the specified objective. Each DQO developed for this project will address nine data-quality element requirements:

1. Project objectives,
2. Data-use perspective,
3. Contaminant or characteristic of interest identified,
4. Media of interest identified,
5. Required sampling areas or locations and depths identified,
6. Number of samples required,
7. Reference concentration of interest or performance criteria,
8. Sampling method identified, and
9. Analytical method identified.

The data-quality objectives are:

- DQO Statement 1, to comply in the future with the requirements of the USACE Permit No. 199910085 conditions (USACE, 2003) as required by Section 404 of the CWA (44 USC 1344) (tables QAPP-1 and -2).
- DQO Statement 2, to monitor currently and in the future the ground water at observation wells near the MUD Platte River West Well Field for contaminants of concern from NOP (tables QAPP-1 and -2).
- DQO Statement 3, to monitor currently and in the future the ground water at observation wells near the MUD Platte River West Well Field to ensure that the Maximum Contaminant Levels (MCLs) are not exceeded as required by the Safe Drinking Water Act (40 CFR 141.11) (tables QAPP-1 and -2).

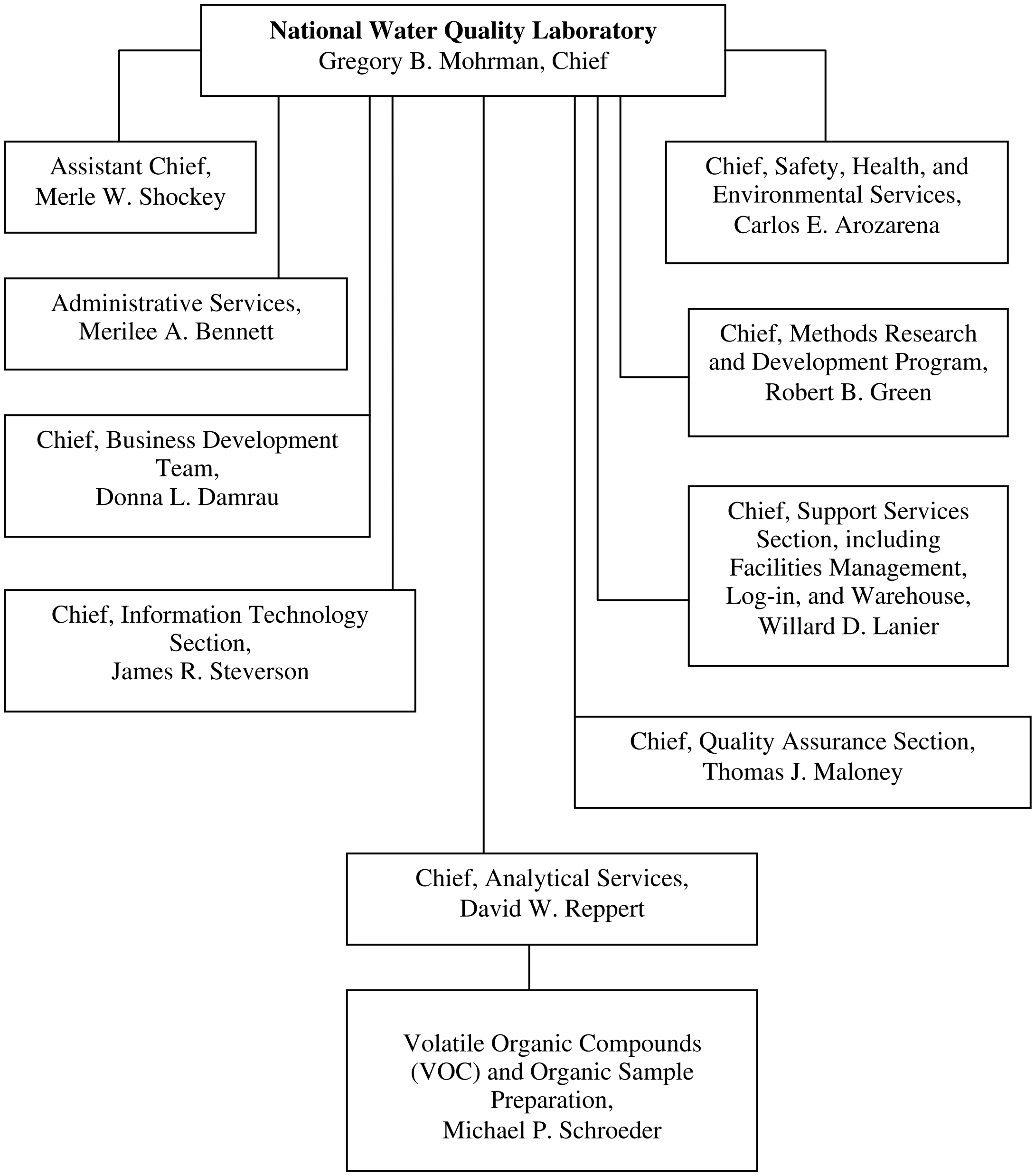


Figure QAPP-1. National Water Quality Laboratory partial-organization chart, effective September 19, 2005 (modified from Maloney, 2005).

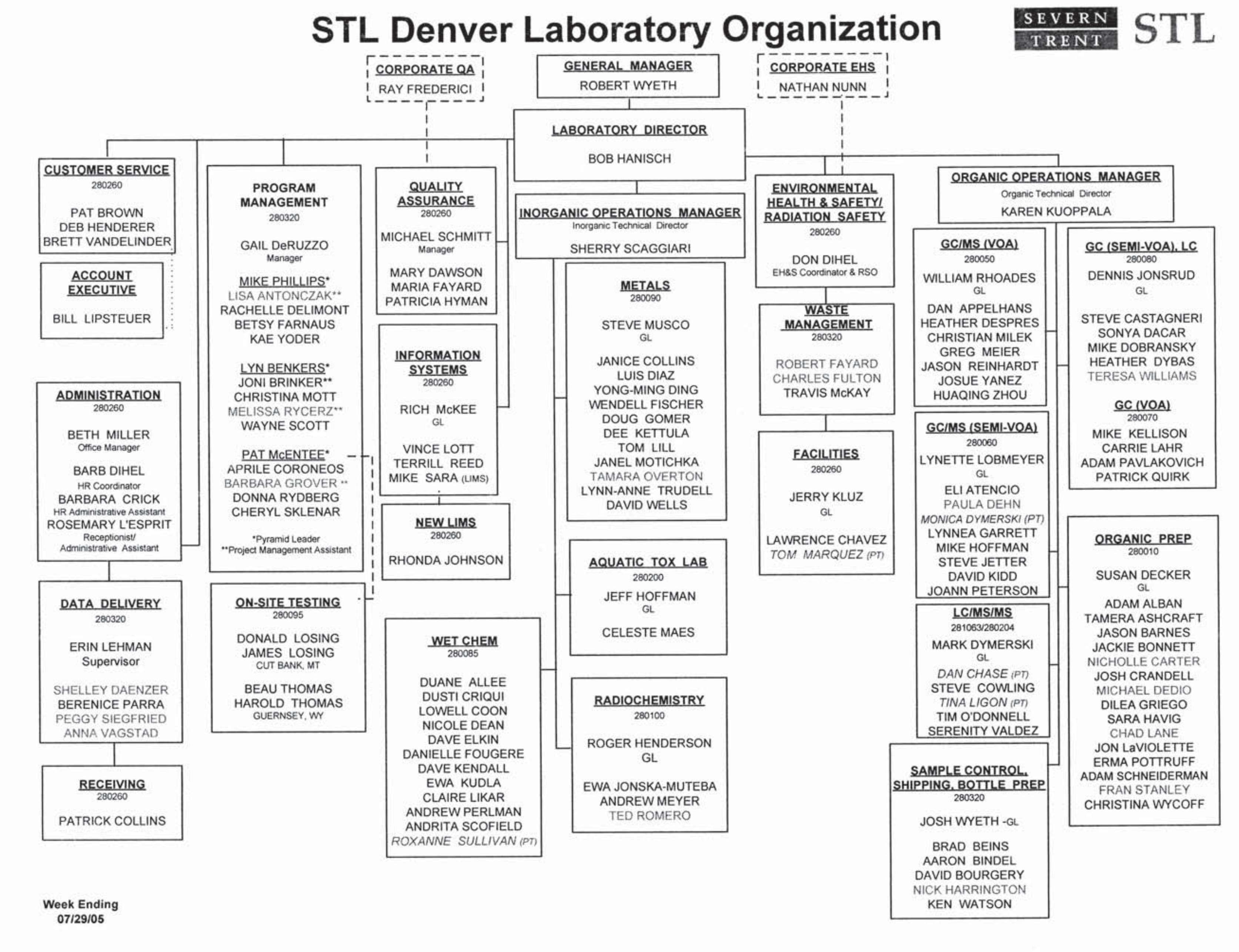


Figure QAPP-2. Severn Trent Laboratory (STL), Denver, Colorado, organization chart effective July 29, 2005 (Wayne Scott, STL, written commun., September 2005).

Table QAPP-1. Data-quality objective elements 1 and 2 for data-quality statements 1 through 3.

[DQO, data-quality objective; USACE, U.S. Army Corps of Engineers; CWA, Clean Water Act; USC, U.S. Code; LPNNRD, Lower Platte North Natural Resource District; MUD, Metropolitan Utilities District; NOP, former Nebraska Ordnance Plant; CFR, Code of Federal regulations]

DQO statement	Element number	Element description	Site-specific DQO statement
Intended data use(s):			
1	1	Project objectives satisfied	To comply currently and in the future with the requirements of the USACE Permit No. 199910085[1] conditions as required by Section 404 of the CWA (44 USC 1344) and LPNNRD well-construction permit requirements.
2	1	Project objectives satisfied	To monitor currently and in the future the ground water at observation wells near MUD Platte River West Well Field for contaminants of concern from NOP near Mead Nebraska.
3	1	Project objectives satisfied	To monitor currently and in the future the ground water at observation wells near MUD Platte River West Well Field for contaminants of concern from the NOP near Mead, Nebraska.
Data need requirements:			
1 and 3	2	Data use perspectives	Compliance with Section 404 of the CWA (33 USC 1344).
2	2	Data use perspectives	To monitor risk and comply with Section 404 of the CWA (33 USC 1344) and the Safe Drinking Water Act (40 CFR 141.11).

[1]USACE (2003).

DQO elements 1 and 2 for DQO statements 1 through 3 are listed in table QAPP-1; DQO elements 3 through 9 are the same for DQO statement 1 through 3 and are listed in table QAPP-2.

This project is not designed as a hypothesis-based study, as such project-specific “tolerable decision errors” cannot be quantified for the study. The probability of type I errors (“false positives”) are minimized during sampling by sampling protocol such as placing the gas generator downwind of the sampling area and wearing clean nitrile gloves during sampling. The probability of type II errors (“false negatives”) are minimized during sampling for the volume of the aquifer affected at the depth sampled by using packers to isolate the sampling area to reduce effects of dilution and by using low-flow sampling procedures to reduce volatilization of the sample (USEPA, 1996a; Puls and Barcelona, 1996; USGS, 1997-2005).

The analyte concentration using NWQL’s VOC analysis by Method O-4127-96, Schedule 1380 is reported as “<” the MRL if the analyte is not detected or if the analyte is detected at concentration less than or equal to the MRL; the analyte concentration is reported as the detected result if the analyte concentration is greater than the MRL (Connor and others, 1998; NWQL, 2004). Method O-4127-96 is also used for Schedule 2020, which is a more extensive and more sensitive NWQL VOC analysis procedure that uses long-term method detection level (LT-MDL) to determine the Schedule 2020’s LRL (Connor and others, 1998; Childress and others, 1999; NWQL, 2004). An LT-MDL is a detection level derived by determining the standard deviation of 20 or more MDL spike-sample measurements conducted over an extended time. Schedule 1380’s MRLs are 2 to 15 times each analyte’s Schedule 2020 LT-MDL. Using Schedule 1380, the chance of NWQL falsely reporting a concentration greater than or equal to MRL for a sample that does not contain the analyte is predicted to be less than or equal to 1 percent and the change of NWQL falsely reporting a nondetection for a sample that contains an analyte at a concentration equal to or greater than MRL is predicted to be less than or equal to 1 percent.

STL uses method detection level (MDL) studies where seven samples at three to five times the estimated MDL concentration are analyzed and an MDL at a 99-percent confidence level is determined for each analyte. MDL studies are conducted annually for each analyte. At STL, for Method 8260B (USEPA, 1996b; STL, 2005) and Method 8321A with SPE (USEPA, 1996c; Penfold, 2001; STL, 2003), LRL is set at 3 to 24 times MDL. STL’s false positive error rate is estimated to be 1 percent, and STL’s false negative error rate is estimated to be 1 percent. STL’s TCE analysis by Method 8260B (USEPA, 1996b; STL, 2005) has an LRL equal to 1.0 μg/L and MDL equal to 0.16 μg/L. STL’s analysis of RDX concentration by Method 8321A has an LRL equal to 0.12 μg/L and an MDL equal to 0.012 μg/L (STL, 2003).

If concentrations of TCE, RDX, dichloropropane [1,2-], and methylene chloride are above LRL in samples from any of the wells, resampling the wells with evidence of contamination will be discussed to verify the results with MUD. If resampling results also are above LRL, meetings with MUD and USACE will determine subsequent action.

Table QAPP-2. Data-quality objective elements 3 through 9 for data-quality objective statements 1 through 3.

[DQO, data-quality objective; TCE, trichloroethylene; RDX, Royal Demolition Explosive or cyclonite or cyclotrimethylene trinitramine; MUD, Metropolitan Utilities District; QC, quality control; SPE, solid-phase extraction; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; VOCs, volatile organic compounds; NWQL, USGS National Water Quality Laboratory, Denver, Colorado; STL, Severn Trent Laboratory, Denver, Colorado; MRL, minimum reporting level; LRL, laboratory reporting level; μg/L, micrograms per liter]

DQO statement	Element number	Element description	Site-specific DQO statement
Data need requirements:			
1,2, and 3	3	Contaminant or characteristic of interest.	TCE and RDX.
1,2, and 3	4	Media of interest.	Ground water.
1,2, and 3	5	Required sampling locations or areas and depths.	Sampling of six observation wells near MUD Platte River West Well Field site will be conducted. Two samples will be obtained: one at the top and one at the bottom of the well screened intervals for wells MW 90-10, 94-3, 94-4, 94-5, 94-6, and 94-7.
1,2, and 3	6	Number of samples required.	1. Sampling, spring 2005—17 samples (12 environmental and 5 QC) analyzed using NWQL Method O-4127-96, Schedule 1380[1] and Method 8321A with SPE[2]. 2. Sampling, fall 2005, spring 2006, and fall 2006—18 samples (12 environmental and 6 QC) analyzed using Method 8260B[3] and 17 samples (12 environmental and 5 QC) analyzed using 8321A with SPE[2].
1,2, and 3	7	Reference concentration of interest or other performance criteria.	NWQL's MRL for TCE is 0.1 μg/L; STL's LRL for TCE is 1 μg/L[1,3]. STL's LRL for RDX is 0.12 μg/L[2]. Expect 90 percent of the scheduled samples to be collected and analyzed; expect concentrations to be less than NWQL's MRL and/or STL's LRL.
Appropriate sampling and analysis methods:			
1,2, and 3	8	Sampling method	Low-flow sampling procedures will comply with the USGS sampling procedures[4].
1,2, and 3	9	Analytical method	1. Sampling, spring 2005—analysis of 61 VOCs, NWQL Method O-4127-96, Schedule 1380[1] and 16 explosive analytes, STL Method 8321A with SPE[2]. 2. Sampling, fall 2005, spring 2006, and fall 2006—analysis of 16 explosive analytes, STL Method 8321A with SPE[2], and 7 VOCs, STL Method 8260B[3].

[1]Connor and others (1998) and NWQL (2004).

[2]USEPA (1996c), Penfold (2001), and STL (2003).

[3]USEPA (1996b) and STL (2005).

[4]USEPA (1996a), Puls and Barcelona (1996), and USGS (1997-2005).

QAPP 3.1 Data-Use Background

The data collected during this project will be used by at least two different groups of users. One group contains four data users—MUD, the owner of the Platte River West Well Field; USACE, Omaha District, and LPNNRD, the permit-issuing agencies; and USEPA Region VII, the Section 404 permit-reviewing agency. MUD was issued a Section 404 CWA (44 USC 1344) permit No. 199910085 by USACE, Omaha District (USACE, 2003) and well-construction permits by LPNNRD. MUD's ultimate goal is compliance with the requirements of CWA, well-installation permits, and the Safe Drinking Water Act; therefore, the sampling protocol was established to determine compliance. The second group of data users contains other Federal, State, and local agencies and the public. Their concern is focused upon the monitoring of the contaminants of concern that potentially could be transported in the ground water from the former NOP. The sampling results will be used to assess contaminant concentrations in the aquifer near MUD's Platte River West Well Field.

QAPP 3.2 Measurement Quality Objectives for Chemical Data

Measurement quality objectives (MQO) are necessary to ensure that quality data are provided by laboratory analysis and allow the eventual compliance review; systematic QC checks are incorporated into the analyses to show that procedures and test results remain reproducible and that the analytical method is actually measuring the quantity of target analytes without unacceptable bias. Systematic QC checks include the scheduled analyses of field and laboratory replicates, standards, surrogates, laboratory spiked samples, and blanks. MQOs (acceptable criteria or ranges) for these systematic QC checks are established to verify data-quality indicators (DQIs) and support data usability and contract compliance, which are described in NWQL's Quality Management System (QMS) (Maloney, 2005) and STL's Laboratory Quality Manual (LQM) (STL, 2000). Refer to section QAPP 6.0 for specific laboratory's DQIs for precision and bias analysis.

QAPP 4.0 Sample-Receipt, Handling, Custody, and Holding-Time Requirements

Custody of the samples prior to shipping will be maintained using the procedures described in FSP.

QAPP 4.1 Verification/Documentation of Sample Conditions

QAPP 4.1.1 National Water Quality Laboratory

Field samples are received by NWQL log-in personnel from a commercial carrier. Samples are accompanied by an ASR (appendix B-2), COC (appendix B-3), and cooler return label.

The log-in personnel will note the condition of the sample containers, including any abnormalities or departures from standard conditions, in the "NWQL log-in comments" field on ASR (appendix B-2) and on the COC (appendix B-3). "No comment" from log-in personnel on ASR indicates the samples were received in proper condition (Maloney, 2005). The COC will be returned to the Project Chief in the return envelope.

For VOC samples that must be chilled to 4°C ± 2°C, the inside temperature of the chilled sample cooler is verified upon opening. The inside temperature is determined with a infrared temperature thermometer, which has been certified by the National Institute of Standards and Technology (NIST), aimed into the cooler at a distance between 6 to 8 in. An accepted inside cooler sample temperature is between –2°C to 6°C. The temperature is recorded on the upper right-hand corner of the ASR (appendix B-2). Coolers with inside temperatures not meeting these criteria will be removed from the sample log-in process and placed into the "problem sample" refrigerator. The NWQL log-in representative will notify the Project Chief regarding further instructions.

If there are other doubts as to a sample's suitability for analysis (for example, broken bottles, incorrect laboratory codes or schedules, and missing coding on ASR (appendix B-2)), the cooler(s) are removed from the log-in process and placed into a "problem sample" refrigerator (Maloney, 2005).

The log-in personnel will enter the sample information into NWQL's LIMS. The data stored in LIMS includes a scanned copy of the ASR (appendix B-2), the site identification number, the sample date and time, the sample medium code, and sample type code. In addition, the log-in personnel can add comments to LIMS such as cooler inside temperature on receipt at NWQL.

Analysis holding times for VOC samples at NWQL are 14 days if the samples are acidified to a pH of less than 2 standard units (Connor and others, 1998; NWQL, 2004). If holding times are not met on any extraction or analysis, the laboratory will proceed with corrective actions as described in section QAPP 4.2 of this report and document their implementation.

QAPP 4.1.2 Severn Trent Laboratory

STL maintains sample custody control for receipt of field samples. STL standard operating procedures (SOPs) are described in the sample receipt, log-in process (STL, 2000). STL log-in personnel enter the samples in the laboratory sample log-in book, and (or) STL's LIMS, which contains the following information at a minimum:

1. Project name and identification number,
2. Unique sample numbers (both client and internal laboratory),
3. Type of samples,
4. Required tests, and
5. Date and time of laboratory receipt of samples.

The log-in personnel will notify STL Project Manager and appropriate STL Group/Team Leader(s) of sample arrival and place the completed COCs (appendix B-4), shipping waybills, and any additional documentation in the project file.

The temperature of the cooler will be checked at log-in and noted on STL CUR form (appendix B-5). A copy of the CUR form (appendix B-5) and the completed COC form (appendix B-4) will be included in the data package that is mailed to USGS Project Chief when the analysis is complete. If the temperature exceeds 4°C ± 2°C, the STL log-in personnel will contact the USGS Project Chief to resolve how to proceed with the samples. After the samples are logged in and appropriate information entered into STL LIMS, STL Project Manager will review the sample log-in information and then E-mail a sample confirmation report to USGS Project Chief.

Analysis holding times for VOC samples at STL are 14 days (STL, 2005). Explosive samples must be extracted within 7 days of collection, and the extracts must by analyzed within 40 days from the date of extraction (STL, 2003). If holding times are not met on any extraction or analysis, the laboratory will proceed with corrective actions as described in section QAPP 4.2 of this report and document their implementation.

QAPP 4.2 Corrective Action for Incoming Samples

Corrective actions for incoming samples are described in detail in NWQL QMS (Maloney, 2005) and STL LQM (STL, 2000).

QAPP 4.2.1 National Water Quality Laboratory

It is the responsibility of the Project Chief to ensure VOC samples are received at NWQL within the 14-day holding time. If the Project Chief thinks the holding time may be compromised, the Project Chief must contact NWQL for assistance (Maloney, 2005). If a VOC sample is analyzed after the 14-day holding time, the analyst and (or) supervisor may decide to "E" code the values to indicate that the value is estimated because of missed holding times (NWQL, 2004).

QAPP 4.2.2 Severn Trent Laboratory

STL is responsible for meeting all holding times for properly preserved samples received within 48 hours of collection or if less than half the holding time has passed. If these conditions are not met, STL will attempt to expedite sample analysis as soon as possible. The Sample Custodian is responsible for documenting incoming samples on COC forms and reporting any deviations from the SOP to the customer service representatives. Each operation has a system in place to ensure that holding times are monitored by each group within the operating unit. When holding times are exceeded, the laboratory uses a nonconformance memo (NCM) to identify and document the root cause of the holding-time violation, which is described in STL LQM (STL, 2000).

QAPP 5.0 Analytical Procedures

Procedures for field sampling are described in FSP. Samples collected in spring 2005 will be analyzed at NWQL and STL; samples collected in fall 2005, spring 2006, and fall 2006 will be analyzed by STL.

QAPP 5.0.1 National Water Quality Laboratory

Samples will be analyzed for VOCs at NWQL utilizing Schedule 1380, which includes analysis for 61 volatile organic analytes in water by purge-and-trap gas chromatography/mass spectrometry (GC/MS) (NWQL, 2004).

QAPP 5.0.2 Severn Trent Laboratory

STL will be responsible for analyzing samples collected in fall 2005, spring 2006, and fall 2006 for selected VOC analytes using Method 8260B based on purge-and-trap GC/MS (USEPA, 1996b; STL, 2005). All samples collected will be analyzed for explosives using Method 8321A with SPE (USEPA, 1996c; Penfold, 2001; STL, 2003) at STL using liquid chromatography/mass spectrometry (LC/MS) with SPE as specified in STL's SOP # DEN-LC-0010 (STL, 2003).

QAPP 5.1 Preventive Maintenance

QAPP 5.1.1 National Water Quality Laboratory

Logbooks will be maintained for each major piece of equipment, with all reference materials applicable to the test performance. These records may include documentation of all routine and nonroutine maintenance activities and reference material verification and may be specific to each analytical schedule or laboratory code (Maloney, 2005).

QAPP 5.1.2 Severn Trent Laboratory

Facilities, instruments, equipment, and parts are subject to wear, deterioration, or change in operational characteristics. Within STL, preventive maintenance, coupled with vendor service agreements, is an organized program of actions taken to maintain control of facilities and equipment.

Each instrument or piece of equipment shall be uniquely identified. The laboratory maintains the following (STL, 2000):

1. Instrument/equipment inventory list;
2. Instrument/equipment major spare parts list or inventory;
3. External service agreement documents, if applicable;
4. Instrument-specific preventive maintenance logbook or file for each functional unit; and
5. Routine and nonroutine maintenance records.

QAPP 5.2 Instrument Calibration

All analytical support areas require that calibrations be performed and documented. These areas include balances, refrigerators, freezers, temperature measurement devices, and volumetric-dispensing devices. Specific calibration procedures and frequencies for each analytical laboratory are discussed in NWQL QMS (Maloney, 2005) and in STL LQM (STL, 2000). The specific calibration procedures and frequencies for each support area are discussed in the following sections.

QAPP 5.2.1 Balances

Analytical balances are used for accurate weighing of samples, reagents, and calibration standards. Prior to use on each working day, or on an as-used basis, balances are checked with NIST-traceable references in the expected-use range. A daily balance calibration check will be performed using class “S” certified weights prior to use. All analytical balances shall have an annual calibration provided by the manufacturer or other qualified service personnel. Each balance is checked for calibration with Class I weights certified by NIST or a NIST-certified entity. As with any instrumentation, the calibration, maintenance, and use are documented in a logbook (STL, 2003, 2005; NWQL, 2004).

QAPP 5.2.2 Refrigerators/Freezers

All refrigerators and freezers shall be monitored for proper operation by measuring and recording internal temperatures on a daily basis. Corrective measures will be implemented if the temperature of the refrigerator is outside of the acceptable range of 2 to 6°C or the freezer temperature is outside the acceptable range of –5°C or lower.

QAPP 5.2.3 Temperature Measurement Devices

All temperature devices, including thermometers, used for temperature measurements shall be calibrated to NIST-traceable standards. Temperatures will be recorded on appropriate dedicated log sheets. Thermometers are replaced if they are out of calibration.

QAPP 5.2.4 Gas Chromatograph/Mass Spectrometer

QAPP 5.2.4.1 National Water Quality Laboratory

GC/MS will be calibrated using the internal standard calibration method. Use of the average response factor is acceptable if the relative standard deviation (SD) of the relative response factors throughout the calibration range is less than or equal to 20 percent (NWQL, 2004).

Reagents and reference standards generally are associated with operational calibrations. Preparation and maintenance of the reagents and standards will be performed as described in the instructions provided in SOPs for each schedule and method. All standards, reagents, and standard solutions will be documented in a logbook that allows the tracking of a standard from the source identification to working standard number, including expiration dates of stock and working standards (NWQL, 2004).

QAPP 5.2.4.2 Severn Trent Laboratory

A series of five or more initial calibration standards is prepared and analyzed for the target compounds and each surrogate compound. Other calibration levels and purge volumes may be used depending on the capabilities of the specific instrument (for example, GC/MS and LC/MS) or program requirements. Calibration levels less than the reporting level may be removed provided there are at least five calibration points and the lowest standard is equal to or less than STL reporting level (STL, 2003, 2005).

STL shall continuously monitor the quality of reagents and standard solutions (STL, 2003, 2005). SOPs require that at a minimum the following primary standards be obtained from or traceable to NIST and that all logbooks should include the following:

- Documentation of the unique identification codes and expiration dates for all reagents and standards used in the analysis,
- Documentation of the purity and concentration of all reagents and standard solutions, including the standard certificates of analysis, and
- Documentation that the purity and concentration were checked prior to use of the reagents and standards.

QAPP 5.3 Laboratory Quality-Control Procedures

Laboratory QC checks are the tools used to evaluate the overall quality of the laboratory analytical results. QC measures to be used by the laboratories when performing the analytical tests, which include both external and internal QC audits and performance evaluations, are described in detail in each laboratory’s operation manual NWQL QMS (Maloney, 2005) and STL LQM (STL, 2000).

QAPP 5.3.1 Analytical Sequence Quality Control

Sequence quality controls are necessary to ensure laboratory systems are operating within acceptable QC guidelines during data generation.

QAPP 5.3.1.1 National Water Quality Laboratory

The data acquired from QC procedures are used to assess the quality of analytical data, to determine the need for corrective action in response to identified deficiencies, and to interpret results after corrective-action procedures are implemented (Maloney, 2005). Each method SOP includes a QC section that addresses the minimum QC requirements for the procedure. The minimal QC sample requirements for USGS Method

O-4127-96, Schedule 1380 (Connor and others, 1998; NWQL, 2004) are:

1. p-Bromoflurobenzene (BFB) tune check,
2. Instrument blanks,
3. Calibration standard concentrations range from 0.1 to 20 μg/L,
4. Continuing calibration verification standards,
5. Set spike—A set spike, a laboratory control sample (LCS), is a synthetic matrix fortified with known and verified concentrations of all the method compounds; the LCS matrix is certified VOC/pesticide grade blank water, which is purged with nitrogen gas within 2 weeks of use. NWQL compared the set spike data to the published test method acceptance criteria for the first year the method is used. After the first year, acceptance criteria were calculated from the previous year's spike data and updated annually.
6. Laboratory report level spike (LRLS)—for USGS Method O-4127-96, Schedule 1380, the MRL is greater than or equal to the lowest calibration standard. A LRLS is processed with each analytical batch and is prepared from third party check standards at two-to-five times the concentration of the calculated LT-MDL (Childress and others, 1999). LRLS data, accumulated over a 6-month or longer period, are compiled into summary statistics and used in the yearly calculation of the LT-MDL for Schedule 2020. The Schedule 2020 LRL are typically set at two times the concentration determined for the LT-MDL (Childress and others, 1999); the Schedule 1380 MRL ranges from approximately equal to up to eight times the concentration determined for the Schedule 2020 LRL. The LRLS for Schedule 1380 is used to monitor that the compounds can be detected in this reagent water standard at a concentration at or very near the MRL. Thus, the LRLS is used primarily as a presence/absence marker for the analytical procedure to verify that the compounds can be routinely detected at the MRL. If the compound is not detected, corrective action may involve adjustment of the reporting level, result qualification, system maintenance, recalibration, and/or reanalysis.
7. Internal standard areas, and
8. Surrogate standards.

QAPP 5.3.1.2 Severn Trent Laboratory

Laboratory QC procedures for STL are described in STL LQM (STL, 2000). Any QC results that fail to meet control criteria must be documented as a nonconformance and require a NCM as described in section QAPP 5.5. The following are QC procedures that must be completed:

1. Method blank,
2. Surrogates,
3. LCS, and
4. Matrix spikes.

QAPP 5.3.2 Batch/Matrix-Specific/Performance-Based Quality Control

Batches are defined at the sample preparation stage. The batch is a set of up to 20 samples of the same type of matrix, plus required QC samples, processed using the same procedures and reagents within the same period. If possible, STL personnel try to keep batches together through the whole analytical process, but they are not required to analyze prepared extracts on the same instrument or in the same sequence. The method blank must be run on each instrument. For further discussion, see NWQL QMS or STL LQM (Maloney, 2005; STL, 2000, respectively).

QAPP 5.4 Performance and System Audits

QAPP 5.4.1 National Water Quality Laboratory

NWQL participates in external performance evaluation (PE) studies. External PE results for NWQL are available at URL *http://nwql.usgs.gov/Public/perf_hdr.html*. NWQL also participates in internal audits, which are conducted on all laboratory processes to verify that current activities follow published methods, approved SOPs, and QMS (Maloney, 2005). Specific QC requirements for analyzing VOCs at NWQL are described in NWQL SOP # OW0279.1 (NWQL, 2004). Any QC samples failing specified requirements will require corrective action.

QAPP 5.4.2 Severn Trent Laboratory

The STL group/team leader has the responsibility to ensure that analysts are properly trained in the procedures and that they have the required skill and experience to interpret data generated by the analysis performed. The following requirements must be completed before samples are analyzed and must be repeated on an annual basis:

1. Demonstration of capability, and
2. MDL.

Method performances are described in more detail in STL SOP # DEN-MS-0010 (STL, 2003) and STL SOP # DEN-LC-0010 (STL, 2005). STL also participates in various proficiency testing programs and external audits related to STL being a National Environmental Laboratory Accreditation Conference (NELAC)- and USACE-approved laboratory.

QAPP 5.5 Nonconformance/Corrective Actions

A nonconformance is an unplanned deviation from an established protocol or plan and in some cases may be exceptionally permitted departures from the documented policies and procedures or from standard specifications.

QAPP 5.5.1 National Water Quality Laboratory

Corrective action begins with the analyst, who is responsible for knowing when the analytical process is meeting acceptable performance requirements. The analyst initiates corrective actions when a QC check exceeds the acceptance limits. Such events include the following:

1. QC outliers,
2. Loss of sample,
3. Equipment malfunctions, and
4. Evidence of sample contamination.

Subsequent audit(s) may be performed to confirm that the corrective actions have been implemented and are effective (Maloney, 2005).

QAPP 5.5.2 Severn Trent Laboratory

Nonconformance is a departure from STL's documented policies and procedures or from a standard specification. The deviation may be the result of STL's actions as a systematic error, which is termed a deficiency. A single isolated nonconformance or nonconformance beyond the control of STL is termed an anomaly.

Nonconformance can be identified on the basis of internal or external systems or performance audits, sample processing, routine calibration and monitoring of analytical and support equipment, or QC sample analyses. STL Technical Director, Operations Manager, Project Manager, QA Manager, Group Leader, and Analyst may be involved in identifying the most appropriate corrective action. All nonconformance deficiencies and anomalies are documented via an electronic process or on a paper form that meets NCM requirements as approved by QA manager. The Clouseau NCM program, which is available on the local-area network throughout the laboratory, is the main vehicle for documenting and communicating NCMs. The program allows anyone in the laboratory to document a nonconformance, explain the cause of the problem, and link to LIMS system to identify the samples and clients involved. It also provides a place to document long-term corrective actions. Refer to STL LQM (STL, 2000) for more details regarding STL nonconformance procedures.

QAPP 6.0 Data-Reduction Procedures/ Calculation of Data-Quality Indicators

Data-reduction procedures, whether performed by the instrument or manually, shall follow methodologies outlined in the laboratory SOPs or analytical method. Project-specific variations of the general procedures, statistical approach, or formulas may be identified, depending on project-specific requirements. Both laboratories utilize software maintained on the instrument computer to calculate the results.

QAPP 6.1 Precision

Precision refers to the distribution of a set of reported values about the mean or the closeness of agreement between individual test results obtained under prescribed conditions. Precision reflects the random error and may be affected by systematic error. Precision also characterizes the natural variation of the matrix and existence or variation of the contamination within that matrix.

Statistical measures of precision include relative percentage difference (relative range for duplicates), SD, or relative SD. Refer to USACE Engineer Manual EM 200-1-3 (USACE, 2001) for calculations.

QAPP 6.1.1 National Water Quality Laboratory

Sample analytical data are interpreted according to protocols described in NWQL SOP # OW0279.1 (NWQL, 2004). Available information used in the calculations (for example, unprocessed data, calibration files, tuning records, results of standard additions, sample response, and blank or background-correction protocols) is recorded to enable reconstruction of the final result in the sample's NWQL data packet.

QAPP 6.1.2 Severn Trent Laboratory

See Section 8 in STL LQM (STL, 2000). Precision calculations are located in STL SOPs DEN-MS-0010 (STL, 2003) and DEM-LC-0010 (STL, 2005).

QAPP 6.2 Bias

Bias refers to the systematic or persistent distortion of a measurement process that causes errors in one direction (above or below the true value or mean). Bias may be affected by errors made in laboratory handling procedures. Bias assessments typically are based on the analysis of spiked reference materials or spiked samples (for example, LCS, matrix spike, matrix spike duplicate, surrogates). When sample matrix is spiked, the result allows an assessment of the effect of the sample matrix on recoveries. Bias values for LCS represent quantitative limits beyond which data are unacceptable. Bias values commonly are expressed as percent recovery as described in EM 200-1-3 (USACE, 2001).

QAPP 6.3 Sample Quantitation/Reporting Limits

MDL is the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the analyte concentration is greater than zero. At NWQL, the procedure for determining Schedule 1380's MRL is not documented due to the fact that the method was developed before the NWQL instituted MDL procedures; at STL, MDL is determined by an MDL procedure. At STL, MDL procedure requires seven replicate analyses. For both laboratories, at MDL concentration, the risk of a false positive is predicted to be less than or equal to 1 percent.

At NWQL, MRL for Schedule 1380 is generally equal to 2 to 15 times each analyte's yearly determined LT-MDL for Schedule 2020. At STL, LRLs for methods 8260B (USEPA, 1996b; STL, 2005) and 8321A with SPE (USEPA, 1996c; Penfold, 2001; STL, 2003) are generally equal to 3 to 24 times the MDL. MRL (NWQL) and LRL (STL) controls false negative error. The probability of falsely reporting a nondetection for a sample that contained an analyte at a concentration equal to or greater than MRL is predicted to be less than or equal to 1 percent for Schedule 1380. The value of MRL (NWQL) or LRL (STL) will be reported with a "less than" remark code for samples in which the analyte was not detected.

QAPP 6.3.1 National Water Quality Laboratory

For the analytes in NQWL method O-4127-96, Schedule 1380, the analyst's initial and continuing demonstration of proficiency with NWQL method must be acceptable before analysis of samples may begin. Results from Schedule 1380 are reported relative to MRL (Connor and others, 1998; NWQL, 2004).

QAPP 6.3.2 Severn Trent Laboratory

For the analytes in each method, the demonstration of capability of STL analyst with the method and MDL studies must be acceptable before analysis of samples may begin. MDL values used for reporting the analytical results are stored in the laboratory LIMS system (STL, 2003, 2005).

QAPP 6.4 Representativeness

Representativeness typically is assured by using a statistically significant number of samples and by collecting randomly selected samples. The wells to be sampled for this project were determined by LPNNRD.

QAPP 6.5 Comparability

For this project, comparability of VOC results will be addressed with accepted sampling and analytical techniques and by reporting data in standard units. Two different methods will be used to analyze for VOC—NWQL's method O-4127-96, Schedule 1380 (Connor and others, 1998; NWQL, 2004) (MRL for TCE equal to 0.1 μg/L) and STL's method 8260B (USEPA, 1996b; STL, 2005) (LRL for TCE equal to 1 μg/L).

Comparability for the explosive results will be addressed with common and accepted sampling and analytical techniques and by reporting data in standard units. Explosives will be analyzed using STL's Method 8321A with SPE (USEPA, 1996c; Penfold, 2001; STL, 2003).

QAPP 6.6 Completeness

The completeness goal for both sampling and analysis in this project is 90 percent—that is, at least 90 percent of the scheduled samples are collected, and for the samples sent in for analysis, 90 percent of the analytical results of the samples are measurements judged to be valid measurements.

NWQL strives to analyze 100 percent of the samples sent in for analysis and strives to report valid measurements on 100 percent of constituent analyzed. At STL, the objective for completeness of data is 90 percent for each constituent analyzed (STL, 2000).

QAPP 7.0 Laboratory Operations Documentation

QAPP 7.1 Sample Management Records

Both NWQL and STL use a LIMS. LIMS is used to monitor samples through receipt and log-in, work assignments, results entry by a manual process or a data-capture utility, QC testing, and release of results to customers (STL, 2000; Maloney, 2005).

QAPP 7.2 Data-Reporting Procedures

QAPP 7.2.1 Data-Package Format and Contents

QAPP 7.2.1.1 National Water Quality Laboratory

NWQL prepares a data package for VOC analysis results that includes the following: analytical run sequence, preparation sheet and notes, calibration report, gas chromatograph retention-time report, BFB reports, tune report, sample results, ASR (appendix B-2), final report, raw data, chromatogram, and spectra, and related summary reports. The data packages will be labeled with the analytical set number (NWQL, 2004). All data package receive a secondary data review by another qualified analyst. Data packages reside at NWQL and are available upon request for an additional charge.

QAPP 7.2.1.2 Severn Trent Laboratory

For each project sampling or sample delivery group (SDG), STL will provide one bound paper copy of the analytical-results summary report. The analytical-results summary report will be paginated and include the following:

1. A case narrative discussion of any log-in problems, nonconformance issues, and sample-analysis anomalies. A discussion of the corrective actions taken whenever laboratory QC procedures or measures are not achieved is included.
2. The original or a copy of the COC form showing date and time of sample receipt and signature of person that received custody of the samples at the laboratory.

3. A copy of the Sample Receiving Checklist and any associated sample log-in nonconformance or anomaly record forms.
4. A summary section listing analytical and preparation methods used.
5. A glossary and footnotes to define acronyms, symbols, data-qualifier codes, and technical terms used in the analytical-results report.
6. A complete cross-reference listing of USGS field and STL sample identification numbers.
7. The analytical results for the environmental samples including USGS field and STL sample identification number, sample matrix type, sample-collection date, sample-preparation date, sample-analysis date and time, analytical method number, dilution factor, target analyte name, reporting level, reporting units, and MDL value. For VOC and explosive analyses, the surrogate recoveries will be included with the analytical results for each sample.
8. For each analytical method, a detailed and complete cross-reference listing of the submitted samples and the associated laboratory QC samples and batches (lots).
9. Results of the laboratory QC samples and associated control limits, including: LCS, LCS duplicates, method blanks, matrix spikes, matrix-spike duplicates, and laboratory duplicates that are applicable for a specific analytical method.

STL also will provide a copy of the analytical summary report and raw-data report as a PDF file on a compact disc for each SDG. The raw-data report will contain the appropriate, legally defensible documentation that is commonly required for formal, third-party data validation, and will include the following applicable documentation by analytical method:

1. Run log pages and preparation log records.
2. Tuning data.
3. Initial calibration data including analysis reports, computer printouts, and bench sheets. Initial calibration data for each column used in the analysis also are required for selected organic analyses.
4. Continuing calibration data including analysis reports, computer printouts, and bench sheets.
5. Internal standards data and results.
6. Raw data records for analysis of environmental samples and associated laboratory QC samples, including chromatograms, reconstructed ion chromatographs for target compounds, tentatively identified compounds, sample spectra, strip charts, and printouts.
7. Documentation of any analytical problems and nonconformance records.

QAPP 7.2.2 Electronic Deliverables

QAPP 7.2.2.1 National Water Quality Laboratory

Routine data are transmitted electronically and stored in NWIS database except custom or provisional data, which are transmitted by memorandum. The results for the analyses from this project will be stored in NWIS. All results are reported according to a strict format that allow for transmission and storage in NWIS. Additional paper reports are not standard and must be requested with specific needs (that is, specific report format, specific protocols, or specific QC samples) on a custom basis (Maloney, 2005).

QAPP 7.2.2.2 Severn Trent Laboratory

Laboratory will provide on a compact disc, data files of sample information and analytical results in the tab-delimited USGS NWIS water-quality (QWDATA) batch-file format. STL will also provide the appropriate laboratory data files for USACE Automatic Data Review (ADR) program.

QAPP 7.3 Data-Management Procedures

QAPP 7.3.1 Laboratory Turnaround Time

QAPP 7.3.1.1 National Water Quality Laboratory

Turnaround time for schedule 1380 is 7 days to extraction from date of arrival at NWQL and 14 days from extraction to analysis.

QAPP 7.3.1.2 Severn Trent Laboratory

STL turnaround time is 30 days, which is established through a contract with USGS, Denver, Colorado. Richard Daddow is USGS COR for USGS contract with STL.

QAPP 7.3.2 Data Archival/Retention Requirements

QAPP 7.3.2.1 National Water Quality Laboratory

VOC data packages are archived at the NWQL for 3 years. Beyond 3 years, the data are archived by the National Archives and Records Administration at the Denver Federal Center for 30 years, at which time they are destroyed unless an extension is requested.

QAPP 7.3.2.2 Severn Trent Laboratory

STL retains copies of records in a manner that allows for prompt retrieval of documents and records for inspection purposes. In accordance with USGS contract with STL, all analytical results and associated QC and raw data results will be properly stored and archived for a minimum of 5 years. Other types of records have different retention times (STL, 2000).

QAPP 8.0 Data-Assessment Procedures

QAPP 8.1 Data Quality-Control Review

All analytical data generated by the laboratories shall be extensively reviewed prior to release of the data to assure the validity of the reported data. This internal data-evaluation process shall cover the areas of data generation, reduction, and QC requirements. The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data.

QAPP 8.1.1 National Water Quality Laboratory

The initial analyst will make all data interpretations regarding both QC samples and analytical samples. A secondary review of the data packages will be performed by an analyst other than the initial analyst. At NWQL, the section supervisors or their designee are responsible for data review (Maloney, 2005).

QAPP 8.1.2 Severn Trent Laboratory

Results are subject to two levels of technical review within STL. The technical reviews are documented on a Data Review Check List, which includes review items such as calibration and calibration verification, client samples, and QC sample results (STL, 2000).

All analytical data and reports on samples submitted to STL for analysis by USGS will be thoroughly reviewed and evaluated by USGS COR to determine if laboratory contract requirements and data deliverables have been completed properly and within specified turn-around times. COR also will conduct a technical review of the laboratory analytical results to provide an overview of potential problems with the determination and quality of the analytical results. This technical review will be documented on a data-review worksheet for each laboratory sample delivery group and includes checking ASR (appendix B-2), sample analytical results and associated laboratory QC data, and if needed selected raw-data results. For this project, COR also will use USACE ADR program (version 6.2). ADR program requires that specified electronic data deliverable (EDD) files containing sample results and associated laboratory QC results be prepared by the laboratory. ADR program performs an error check for correctness and completeness on EDD files. ADR program also performs a data review on the laboratory EDD files that measures the integrity of the sample analytical results in relation to associated laboratory QC data, holding times, and project detection limits.

QAPP 8.2 Data Verification

QAPP 8.2.1 National Water Quality Laboratory

Sample analytical data are interpreted according to protocols described in the method SOPs. Available information used in the calculations (for example, unprocessed data, calibration files, tuning records, results of standard additions, sample response, and blank or background-correction protocols) is recorded to enable reconstruction of the final result if necessary (Maloney, 2005).

QAPP 8.2.2 Severn Trent Laboratory

Data verification starts with the analyst who performs a 100-percent review of the data to ensure the work was done correctly the first time. Data verification continues with review by a second reviewer who verifies that data reduction has been correctly performed and that the analytical results correspond to the data acquired and processed (STL, 2000).

QAPP 8.3 Date-Quality Objectives Reconciliation

USGS Project Chief has two general benchmarks for evaluation of project data—usability and DQOs. Richard Daddow ensures STL complies with USGS contract requirements. The Project Chief must first determine if data are usable by reviewing the analytical results and supporting documentation. The Project Chief also must determine if project DQOs have been met by assessing whether the contaminants of concern are present at concentrations above NWQL's MRL or STL's LRL in ground water from the sampled wells.

The Project Chief will review 100 percent of the data results. NWSC's Water Quality Specialist or another experienced hydrologist will verify 100 percent of the data results. The Project Chief's supervisor or another experienced hydrologist will do a final administrative review of the data results and supporting documentation. The final administrative review will verify that previous reviews were documented properly and that the data package is complete.

QAPP 8.4 Project Completeness Assessment

A chemical-data quality assessment memorandum is used to assess the completeness of sampling and is required by the USACE for MUD's Section 404 permit No. 199910085 (USACE, 2003). This memorandum will not be prepared for the sampling conducted by the USGS for the sampling required by LPNRD in 20005-2006. For future sampling efforts required by the USACE, the elements of the chemical-data quality assessment memorandum could be addressed by the USGS in a web-only USGS Open-File or Scientific Investigation report. The elements, as applicable (USACE, 1997), include:

1. Description of project background and purpose.
2. Summary of DQOs.
3. Summary of sampling activities.
4. Description of deficiencies in sampling, packaging, transportation, storage, or analysis.
5. Restrictions on use of data.

6. Statement of compliance or noncompliance.
7. Data adequacy (including sensitivity requirements).
8. Lessons learned.
9. Corrective actions taken.

References

ANSI/ASQC, 1995, Specifications and guidelines for quality systems for environmental data collection and environmental technology programs: American National Standard, ANSI/ASQC E4-1994, 32 p.

Childress, C.J., Foreman, W.T., Connor, B.F., and Maloney, T.J., 1999, New reporting procedures based on long-term method detection levels and some considerations for interpretations of water-quality data provided by the U.S. Geological Survey National Water Quality Laboratory: U.S. Geological Survey Open-File Report 99-193, accessed August 23, 2005, on the Web at *http://water.usgs.gov/owq/OFR_99-193/.*

Condra, G.E., 1903, An old Platte channel: American Geologist, p. 361-369.

Connor, B.F., Rose, D.L., Noriega, M.C., Murtagh, L.K., and Abney, S.R., 1998, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of 86 volatile organic compounds in water by gas chromatography/mass spectrometry, including detections less than reporting limits: U.S. Geological Survey Open-File Report 97-829 accessed November 13, 2004, at *http://nwql.usgs.gov/Public/pubs/OFR97-829.html*

DOD, 2004, Quality systems manual for environmental laboratories, draft version 3: Department of the Navy, Environmental Data Quality Workshop, Department of Defense data available on the Web, accessed May 27, 2005, at *http://www.navylabs.navy.mil/ManualsDocs.htm*

Ellis, M.J., Engberg, R.A., Kastner, W.M., and Steele, E.K., Jr., 1985, Nebraska—ground-water resources, *in* U.S. Geological Survey, 1985, National water summary 1984, Hydrologic events, selected water-quality trends, and ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, 467 p.

Environmental Chemical Corporation, 2003, Draft final, 2002 Groundwater monitoring program annual report for operable unit no. 2 (groundwater), former Nebraska Ordnance Plant, Mead, Nebraska, DACW41-98-D-9015, Task Order No. 0003, prepared by U.S. Army Corps of Engineers, Kansas City District, October 2003: Lakewood, Colorado, Environmental Chemical Corporation [variously paged].

Maloney, T.J., ed., 2005, Quality management system, version 1.1, effective January 28, 2004: U.S. Geological Survey National Water Quality Laboratory internal document, 119 p.

NWQL, 2004, Analytical procedures for volatile organic compounds by purge and trap gas chromatography/mass spectrometry—standard operation procedure OW0279, effective 10/05/2004: U.S Geological Survey National Water Quality Laboratory internal document, 43 p.

Penfold, Larry, 2001, The new role for LC/MS and LC/MS/MS in explosives investigations, *in* Proceedings of the Seventeenth Annual Waste Testing & Quality Assurance Symposium (WTQA 2001), August 12-16, 2001, Arlington, Virginia: USEPA data available on the Web, accessed November 13, 2004, at *http://www.epa.gov/SW-846/pdfs/final01.pdf*

Puls, R.W., and Barcelona, M.J., 1996, USEPA ground water issue—low-flow (minimal drawdown) ground-water sampling procedures: Office of Research and Development, USEPA/540/S-95/504, 12 p.

STL, 2000, Laboratory quality manual for STL Denver, revision 0, September 27, 2000: Denver, Colorado, Severn Trent Laboratory internal document, 389 p.

STL, 2003, LC/MS analysis of nitroaromatic and nitramine explosive compounds by APCI/MS, Standard Operating Procedure DEN-LC-0010, revision 3, implemented 6/30/2003: Denver, Colorado, Severn Trent Laboratory, internal document, 31 p.

STL, 2005, Determination of volatile organics by GC/MS based on Method 8260B, 624, and 524.2, Standard operating procedure DEN-MS-0010, revision 1, implemented 1/14/2005: Denver, Colorado, Severn Trent Laboratory, internal document, 83 pages.

Souders, V.L., 1967, Availability of water in eastern Saunders County, Nebraska: U.S. Geological Survey Hydrologic Investigations Atlas HA-266, 1 sheet, scale 1:125,000.

Stanley, D.L., Boozer, T.M., and Schroder, L.J., 1998, Summary of the U.S. Geological Survey National Field Quality Assurance Program from 1979 through 1997: U.S. Geological Survey Open-File Report 98-392, 11 p.

Steele, G.V., 2002, Age of ground water at city of Lincoln's municipal well field, near Ashland, Nebraska: U.S. Geological Survey Fact Sheet 091-02, 6 p.

Steele, G.V., and Verstraeten, I.M., 1999, Effects of pumping collector wells on river-aquifer interaction at Platte River Island near Ashland, Nebraska, 1998: U.S. Geological Survey Water Resources Investigations Report 99-4161, 6 p.

Summerside, S.E., 2001, Configuration of the water table, circa 1995: University of Nebraska—Lincoln data available on the Web, accessed November 8, 2004, at *http://csd.unl.edu/csd-esic/gisdata/watertable95.e00*

Swinehart, J.B., Dreeszen, V.H., Richmond, G.M., Tipton, M.J., Bretz, Richard, Steece, F.V., Hallberg, G.R., and Goebel, J.E., 1994, Quaternary geologic map of the Platte River 4° x 6° quadrangle, United States: U.S. Geological Survey Miscellaneous Investigations Series Map I-1420 (NK-14), 1 sheet.

TechLaw, 2004, USEPA contract number 68-W-01-051, DCN RR7-TLI-077R-01-MN-1173, Summary Report, Former Nebraska Ordnance Plant, Saunders County, Nebraska, CERCLIS identification number NE6211890011, July 15, 2004: Overland Park, Kansas, TechLaw, 34 p.

University of Nebraska—Lincoln, Conservation and Survey Division, 2005a, Groundwater level changes in Nebraska—spring 2004 to spring 2005: University of Nebraska—Lincoln data available on the Web, accessed September 26, 2005, at *http://csd.unl.edu/general/gis-datasets.asp#Groundwater-Level_Changes_2004-2005*

University of Nebraska—Lincoln, Conservation and Survey Division, 2005b, Groundwater-level changes in Nebraska—predevelopment to spring 2005: University of Nebraska—Lincoln data available on the Web, accessed September 26, 2005, at *http://csd.unl.edu/general/gis-datasets.asp#Groundwater-Level_Changes_Predevelopment-2005*

URS Greiner Woodward Clyde Federal Services, 2000, 1999-2000 Groundwater monitoring program annual report, operable unit no. 2, former Nebraska Ordnance Plant, Mead, Nebraska, DACW41-96-D-8014, Task Order No. 0002, prepared by U.S. Army Corps of Engineers, Kansas City District, September 2000: Overland Park, Kansas, URS Greiner Woodward Clyde Federal Services [variously paged].

URS Group, Incorporated, 2001, 2000-2001 Groundwater monitoring program annual report, operable unit no. 2, former Nebraska Ordnance Plant, Mead, Nebraska, DACW41-96-D-8014, Task Order No. 0002, prepared by U.S. Army Corps of Engineers, Kansas City District, August 2001: Overland Park, Kansas, URS Group, Incorporated [variously paged].

USACE, 1997, Environmental quality—chemical quality assurance for hazardous, toxic and radioactive waste (HTRW) projects: U.S. Army Corps of Engineers, Engineer Manual 200-1-6, October 10, 1997: accessed April 9, 2005, at *http://www.usace.army.mil/inet/usace-docs/eng-manuals/em200-1-6/toc.htm*

USACE, 1998, Technical project planning (TPP) process: U.S. Army Corps of Engineers Engineering Manual 200-1-2, August 31, 1998, accessed April 13, 2005, at *http://www.usace.army.mil/inet/usace-docs/eng-manuals/em200-1-2/toc.htm*

USACE, 2001, Requirements for the preparation of sampling and analysis plans: U.S. Army Corps of Engineers Engineer Manual 200-1-3, February 1, 2001, accessed April 9, 2005, at *http://www.usace.army.mil/inet/usace-docs/eng-manuals/em200-1-3/toc.htm*

USACE, 2003, Department of Army, Section 404 of the Clean Water Act (44 USC 1344) permit issued May 16, 2003 by U.S. Army Corps of Engineers, Omaha District, to Metropolitan Utilities District (MUD), Permit No. 199910085: U.S. Army Corps of Engineers, 22 p.

USEPA, 1996a, Low stress (low flow) purging and sampling procedure for collection of ground-water samples from observation wells, SOP GW0001, revision 2, July 30, 1996: USEPA data available on the Web, accessed April 12, 2005, at http://www.epa.gov/boston/measure/well/lowflow8.pdf

USEPA, 1996b, Method 8260B, Volatile organic compounds by gas chromatography/mass spectrometry (GC/MS): USEPA data available on the Web, accessed November 13, 2004, at *http://www.epa.gov/epaoswer/hazwaste/test/pdfs/8260b.pdf*

USEPA, 1996c, Method 8321A, Solvent extractable nonvolatile compounds by high performance liquid chromatography/thermospray/mass spectrometry (HPLC/TS/MS) or ultraviolet (UV) detection, revision 1: USEPA data available on the Web, accessed November 13, 2004, at *http://www.epa.gov/epaoswer/hazwaste/test/pdfs/8321a.pdf*

USEPA, 2000, USEPA Guidance for data quality objectives process (EPA QA/G-4): Office of Environmental Information, USEPA/600/R-96/055, USEPA data available on the Web, accessed April 13, 2005, at *http://www.epa.gov/quality/qs-docs/g4-final.pdf*

USEPA, 2001a, USEPA requirements for quality assurance project plans (EPA QA/R-5): Office of Information Management, EPA/240/B-01/003, 24 p.

USEPA, 2001b, USEPA requirements for quality management plans (EPA QA/R2): Office of Information Management, EPA/240/B-01/002, 20 p.

USEPA, 2002, USEPA guidance for quality assurance project plans (EPA QA/G-5), December 2002: Office of Information Management, EPA/240/R-02/009, 58 p.

USEPA, 2004, 2004 Edition of the Drinking Water Standards and Health Advisories: Office of Water, EPA/822/R-04/005, 12 p.

USEPA, 2005, Former Nebraska Ordnance Plant, University of Nebraska investigation and clean-up, Mean, Nebraska: USEPA Region 7 Fact Sheet, 3 p.

USGS, 1997-2005, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9, accessed April 11, 2005, at *http://pubs.water.usgs.gov/twri9A*

Woodward-Clyde Consultants, 1993, Remedial investigation report, operable unit no. 2 (groundwater) for former Nebraska Ordinance Plant, Mead Nebraska, contract no. DACB-41-92-C-0023, prepared for U.S. Army Corps of Engineers, Kansas City District, February 1993: Overland Park, Kansas, Woodward-Clyde Consultants [variously paged].

Woodward-Clyde Consultants, 1995a, Feasibility study report, operable unit no. 2 (groundwater) for former Nebraska Ordinance Plant, Mead Nebraska, contract no. DACB-41-92-C-0023, prepared for U.S. Army Corps of Engineers, Kansas City District, May 1995: Overland Park, Kansas, Woodward-Clyde Consultants [variously paged].

Woodward-Clyde Consultants, 1995b, Proposed plan, operable unit no. 2 (groundwater) for former Nebraska Ordinance Plant, Mead Nebraska, contract no. DACB-41-92-C-0023, prepared by U.S. Army Corps of Engineers, Kansas City District, October. 1995: Overland Park, Kansas, Woodward-Clyde Consultants [variously paged].

Woodward-Clyde Consultants, 1996, Record of decision, operable unit no. 2 (groundwater) for former Nebraska Ordinance Plant, Mead Nebraska, contract no. DACB-41-92-C-0023, prepared by U.S. Army Corps of Engineers, Kansas City District, effective date April 1996, October 1996: Overland Park, Kansas, Woodward-Clyde Consultants [variously paged].

Woodward-Clyde Consultants, 1999, 1998-99 Groundwater monitoring program annual report for former Nebraska Ordinance Plant, Mead Nebraska, draft final, contract no. DACW41-96-D-8014, September 1999: Overland Park, Kansas, Woodward-Clyde Consultants [variously paged].

Appendixes A and B

Appendix A. List of Abbreviations and Acronyms

ADR	Automatic data review
ANSI	American National Standards Institute
ARDC	University of Nebraska—Lincoln's Agricultural Research and Development Center
ASQC	American Society for Quality
ASR	Analytical service request form
BFB	p-Bromoflurobenzene
CAS	Chemical Abstract Service
CFR	Code of Federal Regulation
CH	Member of sampling team who takes care of sampling equipment that contacts the sample
COC	Chain of custody
COR	Contracting Officer's representative
CUR	Condition upon receipt
CWA	Clean Water Act
DCQCR	Daily chemical quality-control report
DH	Member of sampling team who takes care of all operations involving contact with potential sources of contamination in the sampling area
DO	Dissolved oxygen
DOD	U.S. Department of Defense
DQI	Data-quality indicator
DQO	Data-quality objective
EDD	Electronic data deliverable
FSP	Field Sampling Plan
GC/MS	Gas chromatography/mass spectrometry
GWQN	Ground-water quality notes form
HA	Health advisory
HCL	Hydrochloric acid
HIF	U.S. Geological Survey Hydrologic Instrumentation Facility
LC/MS	Liquid chromatography/mass spectrometry
LCS	Laboratory control sample
LIMS	Laboratory Information Management System
LPNNRD	Lower Platte North Natural Resources District
LQM	Laboratory Quality Manual of Severn Trent Laboratory
LRL	Laboratory reporting level
LRLS	Laboratory report level spike
LT-MDL	Long-term method detection limit
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Limit Goal
MDL	Method detection limit
MQO	Measurement quality objectives
MRL	Minimum reporting level
MSDS	Material safety data sheets
MUD	Metropolitan Utilities District
NCM	Nonconformance memo
NELAC	National Environmental Laboratory Accreditation Conference
NFQA	National Field Quality Assurance Program
NIST	National Institute of Standards and Technology
NOP	Nebraska Ordnance Plant, Mead, Nebraska
NWIS	National Water Information System (U.S. Geological Survey)
NWSC	U.S. Geological Survey Nebraska Water Science Center
NWQL	U.S. Geological Survey, National Water Quality Laboratory
PE	Performance evaluation
PPE	Personal protection equipment
PVC	Polyvinyl chloride
QA	Quality assurance
QAPP	Quality assurance project plan
QAS	Quality-Assurance Section of U.S. Geological Survey National Water Quality Laboratory
QC	Quality control
QMS	Quality management system of National Water Quality Laboratory
QWDATA	The water-quality part of the USGS National Water Information System
RDX	Royal Demolition Explosive or cyclonite or cyclotrimethylene trinitramine
SAP	Sampling and Analysis Plan
SD	Standard deviation
SDG	Sample delivery group
SOP	Standard operating procedure
SPE	Solid-phase extraction
STL	Severn Trent Laboratory
TCE	Trichloroethylene
TNT	Trinitrotoluene
TT	Treatment technique
UNL	University of Nebraska-Lincoln
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	Volatile organic compound

Appendix B. Standard Forms

Version 6: 11/2004

U. S. GEOLOGICAL SURVEY GROUND-WATER QUALITY NOTES

NWIS RECORD NO ________________________

Station No.______________________________ Station Name ________________________________ Field ID ________________

Sample Date ___________________________ Mean Sample Time (watch) ______________ Time Datum ________ (eg. EST, EDT, UTC)

Sample Medium _______ Sample Type _______ Sample Purpose (71999) ________ Purpose of Site Visit (50280) ________

Project No. _______________ Proj Name______________________ Project No. _______________ Proj Name__________________

Sampling Team ____________________________________ Team Lead Signature __________________________ Date __________

Sample Set ID ______

LABORATORY INFORMATION

Samples Collected: NUTRIENTS _____ MAJOR IONS _____ TRACE ELEMENTS: filtered _____ unfiltered ____ MERCURY: filtered ____ unfiltered ____ MICROBIOLOGY ____

ORGANICS: filtered ____ unfiltered _____ PEST ____ VOC ____ RADIOCHEMICALS: filtered ____ unfiltered ____ RADON ____ (Radon samp coll time:_________)

ISOTOPES ____ DOC ____ TPC ___ (vol filtered _____mL) PIC ___ (vol filtered _____mL) TPC (QC) ___ (vol filtered _____ mL) OTHER ___________ __________

Lab Schedule: ___________ ___________ ___________ ___________ ___________ ___________ ___________ ___________ ___________

Lab Codes: __________ ADD/DELETE __________ ADD/DELETE __________ ADD/DELETE __________ ADD/DELETE __________ ADD/DELETE __________ ADD/DELETE

COMMENTS ____ Date Shipped _________________

****Notify the NWQL in advance of shipment of potentially hazardous samples—phone 1-866-ASK-NWQL or email LabLogin@usgs.gov**

FIELD MEASUREMENTS

STATIC WATER LEVEL (72019) ___________ ft

TEMP, WATER (00010) ____________ °C

ANC ( ) ________________ mg/L

FLOW RATE (00059) _________________ gpm

pH (00400) __________________ units

ALKALINITY ( ) ______________ mg/L

SAMPLING DEPTH (78890) ___________ ft blw MSL

COND (00095) __________ µS/cm@25 °C

BICARBONATE ( ) _____________ mg/L

TOP OF INTERVAL (72015) ___________ ft blw LSD

DIS. OXYGEN (00300) _____________mg/L

CARBONATE ( ) ______________ mg/L

BTM OF INTERVAL (72016) __________ ft blw LSD

DO SAT. (00301) ________________ %

HYDROXIDE ( ) ________________ mg/L

PUMPING PERIOD (72004) _______________min

BAROMETRIC PRES. (00025) _______ mm Hg

HYD. SULFIDE ODOR? (71875) Yes No

TEMP, AIR (00020) ______________ °C

eH (00090) ______________ mvolts

DIS. SULFIDE, MEAS. (99119) __________mg/L

TURBIDITY ( ) ___________ METHOD CODE ______
UNITS: FNU NTRU FNMU FBU

OTHER: ___________ _________________

OTHER: ___________ ____________________

SAMPLING INFORMATION

Sampler Type (84164) ______ Sampler/Pump Type (make/model) ____________________________ Pump/Sampler ID _______________

Sampling Method (82398) ______________ Sampling Condition (72006) _______________

Sampler Material: STAINLESS STEEL PVC TEFLON OTHER _________ Tubing Material: TEFLON PLASTIC TYGON COPPER OTHER ________

Aquifer name ____ Depth pump set at: ______________ft blw LSD MSL

Sampling point description ____

GW Color _________ GW Clarity ________ GW Odor _________ Sample in contact with: ATMOSPHERE OXYGEN NITROGEN OTHER ______

Weather : ***SKY-*** CLEAR PARTLY CLOUDY CLOUDY ***PRECIPITATION-*** NONE LIGHT MEDIUM HEAVY SNOW SLEET RAIN MIST ________

WIND- CALM LIGHT BREEZE GUSTY WINDY EST. WIND SPEED __________ MPH ***TEMPERATURE-*** VERY COLD COOL WARM HOT

OBSERVATIONS:

COMPILED BY :_____________ DATE ________ CHECKED BY :_____________ DATE ________ LOGGED INTO NWIS BY: ____________ DATE __________

GW form ver. 6.0

Appendix B-1. USGS Ground-water quality notes (GWQN) form.

STN NO____________________________

WELL DATA

WELL___ SPRING___ MONITOR___ SUPPLY___ OTHER__________________

SUPPLY WELL PRIMARY USE: DOMESTIC__ PUBLIC SUPPLY__ IRRIGATION __ OTHER________

Comments: ____

Altitude: _____________ ft Casing Material: _______________

Measuring Point: ________ ft ABV BLW LSD MSL Well Depth, ft blw LSD MSL _________

Static Water Level, ft blw LSD MP _________ Date measured __ __/__ __/__ __ __ __

Water level status ________ (leave this field blank if wl measured represents a static level)
Water level method ________ (for list of options, see page 8)

Pumping Water Level, ft blw LSD MP MSL __________

Casing Volume (gal) = 0.0408 X (D)² (H) OR **Casing Volume = H X F**

H = Height (ft) of water column
F = Casing Volume Factor (see table below)
D = Inside Diameter (in) of well
N = Number of well volumes to be removed during purging

H = Well Depth - Static water Level = ___________

Diameter, inside, in. = ___________

1 Casing Volume, gal. = ___________

Actual Purge Volume = (Casing Volume) X (N) = ____________

	VOLUME FACTORS												
DIAMETER (in.)	1.0	1.5	2.0	3.0	4.0	4.5	5.0	6.0	8.0	10.0	12.0	24.0	36.0
CASING VOL. FACTOR (F)	0.04	0.09	0.16	0.37	0.65	0.83	1.02	1.47	2.61	4.08	5.88	23.5	52.9

Depth to Water and Well Depth

	1ST	2ND	3R (optional)
Time			
Hold (for DTW)			
Cut			
= DTW from MP			
– Measuring point (MP)			
= DTW from LSD			
Hold (for well depth)			
+ Length of tape leader			
= Well depth below MP			
– MP			
= Well depth below LSD			

Depth to set pump from MP (all units in feet) **:**	
Distance to top of screen from LSD	
+ MP	
– (7 to 10 x dia. of the well)	
= Depth to pump from MP	
Depth to pump from LSD (all units in feet) **:**	
– MP	
= Depth pump set from LSD MSL	

Screened/Open Interval: TOP _________.____ ft blw LSD MSL Bottom __________.____ ft blw LSD MSL

Depth to Top of Sample Interval _______.____ft blw LSD MSL Depth to Bottom of Sample Interval, ft blw LSD MSL _______.____

Allowable Drawdown, ft __________.____

TURBIDITY CALIBRATION

Meter: MAKE/MODEL ______________________ S/N __________________ Type: TURBIDIMETER SUBMERSIBLE SPECTROPHOTOMETER

Sample: PUMP DISCHARGE LINE FLOW-THRU CHAMBER SINGLE POINT AT _______ ft BLW LSD MSL MP

Sample: COLLECTION TIME: ________ MEASUREMENT TIME: ________ MEASUREMENT: IN-SITU/ON-SITE VEHICLE DISTRICT LAB NWQL OTHER _______

Sample diluted? Y N Vol. of dilution water ________ mL Sample volume ________ mL

TURBIDITY VALUE = A X (B+C) / C

Calibration Criteria: ± 0.5 TU or ± 5%	**Lot Number or Date Prepared**	**Expiration Date**	**Concentration ________ (units)**	**Temperature °C**	**Initial instrument reading**	**Reading after adjustment**
Stock Turbidity Standard						
Zero Standard *(DIW)*						
Standard 1						
Standard 2						
Standard 3						

A= TURBIDITY VALUE IN DILUTED SAMPLE
B= VOLUME OF DILUTION WATER, mL
C= SAMPLE VOLUME, mL

Comments:

Field Readings #1 ___________ #2 ___________ #3 ___________ #4 ___________ #5 ___________

MEDIAN ________ **Parameter Code** _________ FNU NTRU FNMU FBU **METHOD CODE** ___ **Remark Codes(s)** ___ ___ **Qualifier(s)** ___ ___

GW form ver. 6.0

Appendix B-1. USGS Ground-water quality notes (GWQN) form.—Continued

Calibrated by:_______________________________ STN NO____________________________

Date:_________________ Time:_____________

METER CALIBRATIONS/FIELD MEASUREMENTS

TEMPERATURE Meter make/model _______________ S/N _____________ Thermister S/N ____________ Thermometer ID ________

Lab Tested against NIST Thermometer/Thermister? Y N Date: __________________ ±___________ °C

Measurement Location : FLOW-THRU CHAMBER SINGLE POINT AT _______ ft blw LSD VERTICAL AVG. OF ____ POINTS

Field Readings # 1 _______ # 2 _______ # 3 _______ # 4 _______ # 5 _______ **MEDIAN**:_______ **ºC** Remark ___ ___ Qualifier ___ __

pH Meter make/model _________________ S/N _______________ Electrode No. ___________ Type: GEL LIQUID OTHER _________

Sample: FILTERED UNFILTERED FLOW-THRU CHAMBER SINGLE POINT AT _______ ft blw LSD VERTICAL AVG. OF ____ POINTS

pH Buffer	Buffer Temp	Theoretical pH from table	pH Before Adj.	pH After Adj.	Slope	Millivolts
pH 7						
pH 7						
pH 7						
pH ___						
pH ___						
pH ___						
CHECK pH ___						

Temperature correction factors for buffers applied? Y N

BUFFER LOT NUMBERS : pH 7: _________________________

pH ____: _________+________________

CHECK pH ____: _________________________

BUFFER EXP. DATES: pH 7: _________________________

pH ____ : _________________________

CHECK pH ____: _________________________

Calibration Criteria: ± 0.2 pH units

Field Readings # 1 _______ # 2 _______ # 3 _______ # 4_______ # 5 _______ **MEDIAN:** _______ **units** Remark __ __ Qualifier __ __

SPECIFIC CONDUCTANCE Meter make/model _____________________ S/N _______________ Sensor Type: Dip Flow-thru Other ______

Sample: Flow-thru chamber Single point at ________ ft blw lsd Vertical avg. of ______ points

Std Value µs/cm	Std Temp	SC Before Adj.	SC After Adj.	Std Lot No.	Std Exp. Date

Calibration Criteria: the greater of 5 µS/cm or 3% of measured value

AUTO TEMP COMPENSATED METER ___

MANUAL TEMP COMPENSATED METER ___

CORRECTION FACTOR APPLIED? Y N

CORRECTION FACTOR= _____________

Field Readings # 1 _______ # 2 _______ # 3 _______ # 4 _______ # 5 _______ **MEDIAN:** _______**µs/cm** Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter make/model _________________________ S/N ______________________ Probe No. __________________

Sample: Flow-thru chamber Single point at _______ ft blw lsd Vertical avg. of _____ points BOD bottle stirrer Used? Y N

Air Calibration Chamber in Water Air-Saturated Water Air Calibration Chamber in Air Winkler Titration Other ______________________

Water Temp ºC	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Corr. Factor	DO Before Adj.	DO After Adj.

Calibration Criteria: ± 0.3 mg/L

Zero DO Check _________mg/lL Adj. to _________ mg/L Date: ______________

Zero DO Solution Date__________ Thermister Check? Y N Date_________

Membrane Changed? N Y Date: ________________ Time: ________

Barometer Calibrated? N Y Date: __________________ Time: ________

Battery Check: REDLINE _____ RANGE ______________

Field Readings # 1 ________ # 2 _______ # 3 _______ # 4_______ # 5 ________ **MEDIAN:** ________ **mg/L** Remark___ ___ Qualifier___ ___

GW form ver. 6.0

Appendix B-1. USGS Ground-water quality notes (GWQN) form.—Continued

STN NO______________________________

WELL PURGE LOG

Purge method: STANDARD _______ LOW-FLOW _____ OTHER ________________________

TIME	WATER LEVEL BLW MP LSD ft	DRAWDOWN ft	WELL YIELD gpm	PUMPING RATE gpm	WATER TEMP ºC	CONDUCTIV-ITY μs/cm	pH units	DISSOLVED OXYGEN mg/L	TURBID-ITY ______	COMMENTS [CLARITY, ETC.]
										MEDIAN VALUES
										QUIESCENT pH
										FINAL FIELD MEASUREMENTS

PARAMETER	STABILITY CRITERIA*
pH	± 0.1 units (±0.05 units if instrument displays 2 or more digits to the right of the decimal)
Temperature	± 0.2° C (thermistor)
Specific electrical Conductance (SC)	± 5 %, of SC £100 μS/cm ± 3 %, for SC > 100 μS/cm
Dissolved Oxygen (DO)	± 0.3 mg/L
Turbidity (TU)	± 10%, for TU< 100: ambient TU is < 5 for most ground-water systems (visible TU > 5)

*Allowable variation between 5 or more sequential field-measurement values

Notes, Calculations

Appendix B-1. USGS Ground-water quality notes (GWQN) form.—Continued

STN NO______________________________

ALKALINITY/ANC CALCULATIONS

BEGINNING H_2O TEMP. __________ ºC

pH	ΔpH	VOL ACID DC OR mL	ΔVOL ACID DC OR mL	ΔpH / ΔVOL ACID

END H_2O TEMP. __________ ºC

BEGINNING H_2O TEMP. ___________ ºC

pH	ΔpH	VOL ACID DC OR mL	ΔVOL ACID DC OR mL	ΔpH / ΔVOL ACID

END H_2O TEMP. __________ ºC

FIRST TITRATION RESULTS

DATE ___________________________

BEGIN TIME _____________END TIME_____________

ALKALINITY/ANC ______________ meq/L

ALKALINITY/ANC ______________ mg/L AS $CaCO_3$

BICARBONATE______mg/L ______meq/L AS HCO_3^-

CARBONATE_______mg/L ______ meq /L AS CO_3^{2-}

ACID: 1.6N 0.16N 0.01639N

OTHER:________________________________

ACID LOT NO. __________________________

ACID EXPIRATION DATE __________________

SAMPLE VOLUME: _______________mL

FILTERED UNFILTERED

METHOD: INFLECTION POINT GRAN

FIXED ENDPOINT

STIRRING METHOD: MAGNETIC MANUAL

SECOND TITRATION RESULTS

DATE ___________________________

BEGIN TIME ____________END TIME_____________

ALKALINITY/ANC ______________ meq/L

ALKALINITY/ANC ______________ mg/L AS $CaCO_3$

BICARBONATE ______mg/L ______meq/L AS HCO_3^-

CARBONATE _______mg/L ______ meq /L AS CO_3^{2-}

ACID: 1.6N 0.16N 0.01639N

OTHER:________________________________

ACID LOT NO. __________________________

ACID EXPIRATION DATE __________________

SAMPLE VOLUME: _______________mL

FILTERED UNFILTERED

METHOD: INFLECTION POINT GRAN

FIXED ENDPOINT

STIRRING METHOD: MAGNETIC MANUAL

CALCULATIONS

ALKALINITY OR ANC (meq/L) = 1000 (B) (C_a) (CF) / V_s

ALKALINITY (mg/L AS $CaCO_3$) = 50044 (B) (C_a) (CF) / V_s

where:

B = volume of acid titrant added from the initial pH to the bicarbonate equivalence point (near pH 4.5), in milliliters. To convert from digital counts to milliliters, divide by 800 (1.00 mL = 800 counts)

C_a = concentration of acid titrant, in milliequivalents per milliliter (same as equivalents per liter, or *N*)

CF = correction factor (obtain from OWQRL for Hach acid cartridges of certain lot numbers — default value is 1.00)

V_s = volume of sample, in milliliters

For samples with pH ≤ 9.2:

BICARBONATE (meq/L) = 1000 (B-2A) (C_a) (CF) / V_s

BICARBONATE (mg/L) = 61017 (B-2A) (C_a) (CF) / V_s

CARBONATE (meq/L) = 2000 (A) (C_a) (CF) / V_s

CARBONATE (mg/L) = 60009 (A) (C_a) (CF) / V_s

where:

A = volume of acid titrant added from the initial pH to the carbonate equivalence point (near pH 8.3), in milliliters. To convert from digital counts to milliliters, divide by 800 (1.00 mL = 800 counts)

NOTE: For samples with pH > 9.2, these equations for bicarbonate and carbonate will fail to give accurate results. Use the Alkalinity Calculator at http://oregon.usgs.gov/alk or PCFF.

HACH CARTRIDGE CORRECTION FACTOR ___________

[SEE OWQ WAQI NOTES FOR INFO]

pH meter calibration	Meter make/model:		S/N	
Electrode No.		Type: gel liquid other	Slope	Milli-volts
pH buffer	**Buffer temp**	**Theoretical pH from table**	**pH before adj.**	**pH After adj.**
pH 7				
pH __				
Check pH ___				

Comments/Calculations:

GW form ver. 6.0

Appendix B-1. USGS Ground-water quality notes (GWQN) form.—Continued

STN NO____________________________

QUALITY-CONTROL INFORMATION

LOT NUMBERS

PRESERVATIVE LOT NUMBERS

PLACE LABELS FROM VIALS ON SAMPLE BOTTLES

7.5N HNO_3 ____________ (METALS&CATIONS)   6N HCl ____________ (Hg)   4.5N H_2SO_4 ________________ (NUTRIENTS&DOC)   Conc. H_2SO_4 _____________ (COD, PHENOL, O&G)   NaOH _________________ (CYANIDE)

OTHER ____________________   1:1 HCl _________________ (VOC)   Number of drops of HCL added to lower pH to ≤ 2 _____   (**NOTE:** Maximum number of drops = 5)

BLANK WATER LOT NUMBERS

Inorganic (99200) ________________________   2nd Inorganic (99201) ______________________

Pesticide (99202) ________________________   2nd Pesticide (99203) _______________________   Spike vials (99104) _____________________

VOC/Pesticide (99204) ____________________   2nd VOC/Pesticide (99205) __________________   Surrogate vials _______________________

FILTER LOT NUMBERS

capsule___________________________   pore size _______________   type _____________________________

disc______________________________   pore size _______________   type _____________________________

plate _____________________________   pore size _______________   type _____________________________

organic carbon ____________________   pore size _______________   type _____________________________

other _____________________________   pore size _______________   type _____________________________

QC SAMPLES

WERE QC SAMPLE COLLECTED?   **YES**   **NO**

Starting date for set of samples (99109) (YYMMDD) _____________

Ending date for set of samples (99110) (YYMMDD) ______________

Sample Type	NWIS Record No.	Sample Type	NWIS Record No.	Sample Type	NWIS Record No.
Equip Blank ____	_____________	Sequential ____	______________	Trip Blank ____	______________
Field Blank ____	_____________	Spike ____	______________	Other ___________	______________
Split ____	_____________	Concurrent ____	______________	Other ___________	______________

NWQL Schedules/lab codes (QC Samples) __________ _________ _________ _________ _________ _________ _________ _________ _________

COMMENTS ____

(Circle appropriate selections)

99100 Blank-solution type
- 10 Inorganic grade (distilled/deionized)
- 40 Pesticide grade (OK for organic carbon)
- 50 Volatile-organic grade (OK for inorganic, organic, and organic carbon)
- 80 Universal blank water
- 200 Other

99101 Source of blank water
- 10 NWQL
- 40 NIST
- 55 Wisconsin District Mercury Lab
- 200 Other

99105 Replicate-sample type
- 10 Concurrent
- 20 Sequential
- 30 Split
- 40 Split-Concurrent
- 50 Split-Sequential
- 200 Other

99102 Blank-sample type
- 1 Source Solution
- 30 Trip
- 60 Filter
- 70 Preservation
- 80 Equipment (done in non-field environment)
- 90 Ambient
- 100 Field
- 200 Other

99111 QC sample associated with this environmental sample
- 1 No associated QA data
- 10 Blank
- 30 Replicate Sample
- 40 Spike sample
- 100 More than one type of QA sample
- 200 Other

99108 Spike-solution volume, mL _______________

99106 Spike-sample type
- 10 Field

99107 Spike-solution source
- 10 NWQL

99112 Purpose, Topical QC data
- 1 Routine QC (non-topical)
- 10 Topical for high bias (contamination)
- 20 Topical for low bias (recovery)
- 100 Topical for variability (field equip)
- 110 Topical for variability (field collection)
- 120 Topical for variability (field personnel)
- 130 Topical for variability (field processing)
- 140 Topical for variability (shipping&handling)
- 200 Topical for variability (lab)
- 900 Other topical QC purpose

GW form ver. 6.0

Appendix B-1. USGS Ground-water quality notes (GWQN) form.—Continued

REFERENCE LIST FOR CODES USED ON THIS FORM

Sample Medium Codes
6 Regular Ground water
S Quality-control sample (associated environmental sample –6 (GW))
For replicates and spikes
Q Artificial

Value Qualifiers
e see field comment
f sample field preparation problem
k counts outside the acceptable range

Null-value Qualifiers
e required equipment not functional or available
f sample discarded; improper filter used
o insufficient amount of water

71999 Sample purpose
10 Routine
15 NAWQA
50 GW Network
110 Seepage Study
120 Irrigation Effects
130 Recharge
140 Injection

Sample Type Code
9 Regular
7 Replicate
2 Blank
1 Spike

A COMPLETE SET OF FIXED-VALUE CODES CAN BE FOUND ON-LINE AT: http://wwwnwis.er.usgs.gov/currentdocs/index.html

00003 Sampling depth, ft blw LSD
00059 Sampling flow rate, GPM
72004 Pump or flow period prior to sampling, minutes
72019 Water level, ft blw LSD

Time Datum Codes

Time Zone	Std Time Code	UTC Offset (hours)	Daylight Time Code	UTC Offset (hours)
Hawaii-Aleutian	HST	-10	HDT	-9
Alaska	AKST	-9	AKDT	-8
Pacific	PST	-8	PDT	-7
Mountain	MST	-7	MDT	-6
Central	CST	-6	CDT	-5
Eastern	EST	-5	EDT	-4
Atlantic	AST	-4	ADT	-3

84164 Sampler type
4010 Thief Sampler
4020 Open-top Bailer
4025 Double-valve Bailer
4030 Suction Pump
4035 Submersible Centrifugal Pump
4040 Submersible Positive-pressure Pump
4041 Submersible Helical Rotor Pump
4045 Submersible Gear Pump
4050 Bladder Pump
4060 Gas Reciprocating Pump
4070 Gas Lift
4075 Submersible Piston Pump
4080 Peristaltic Pump
4090 Jet pump
4095 Line-Shaft Turbine Pump
4100 Flowing Well
8010 Other

82398 Sampling method
4010 Thief sampler
4020 Open-top bailer
4025 Double-valve bailer
4030 Suction pump
4040 Submersible pump
4045 Submersible multiple impeller (turbine) pump
4050 Squeeze pump
4060 Gas reciprocating pump
4070 Gas lift
4080 Peristaltic pump
4090 Jet pump
4100 Flowing well
4110 Resin trap collector
8010 Other

50280 Purpose of site visit
2001 Primary (primary samples should not exist for a site for more than one date per HIP, and the primary sampling date generally has the highest number of NAWQA analytes)
2002 Supplemental (to fill in missing schedules not sampled or lost)
2003 Temporal characterization (for previously sampled schedules; includes LIP and seasonal samples)
2004 Resample (to verify questionable concentrations in primary sample)
2098 Ground-water quality control
2099 Other (ground-water related samples with medium code other than "6", such as soil samples or core material)

72006 Sampling Condition
0.01 The site was dry (no water level is recorded)
0.02 The site had been flowing recently
0.03 The site was flowing, head could not be measured
0.04 A nearby site that taps the Aquifer was flowing
0.05 Nearby site tapping same Aquifer had been flowing recently
0.06 Injector site
0.07 Injector site monitor
0.08 Measurement discontinued
0.09 Obstruction encountered in well above water surface
0.10 The site was being pumped
0.11 The site had been pumped recently
0.12 Nearby site tapping the same Aquifer was being pumped
0.13 Nearby site tapping the Same Aquifer was pumped recently
0.14 Foreign substance present on the surface of the water
0.16 Water level affected by stage in nearby site
0.17 Other conditions affecting the measured water level
2 Undesignated
4 Flowing
6 Flowing on gas lift
8 Pumping
10 Open hole
18 Producing
19 Circulating
22 Lifting
23 Flowing to Pit
24 Water Flooding
25 Jetting
30 Seeping
31 Nearby well pumping
32 Nearby well taking water
33 Well taking water

GWSI—Water Level Status

_	Leave blank	If water level measured represents a static level, leave this field blank
A	Atmospheric	Water level affected by atmospheric pressure
B	Tide Stage	Water level affected by tide stage
D	Dry	Site was dry (no water level is recorded)
E	Recently flowing	Site was flowing recently
F	Flowing	Site was flowing and the head could not be measured (no water level is recorded)
G	Nearby flowing	Nearby site that taps the same aquifer was flowing
H	Nearby recent flow	Nearby site that taps the same aquifer had been flowing recently
I	Injector site	Injector site (recharge water being injected into the aquifer)
J	Injector monitor	Injector site monitor (a nearby site that taps the same aquifer is injecting recharge water)
M	Plugged	Well plugged and not in hydraulic contact with formation
N	Discontinued	Measurement discontinued
O	Obstruction	Obstruction was encountered in the well above the water surface (no water level recorded)
P	Pumping	Site was being pumped
R	Recently pumped	Site had been pumped recently
S	Nearby pumping	Nearby site that taps the same aquifer was being pumped
T	Nearby recently pumped	Nearby site that taps the same aquifer had been pumped recently
V	Foreign substance	Foreign substance present on the surface of the water
W	Destroyed	Well destroyed (no water level recorded)
X	SW effects	Water level affected by stage in nearby surface-water site
Z	Other	Other conditions that would affect the measured water level (explain in remarks)

ALKALINITY/ANC PARAMETER CODES
39086 Alkalinity, water, filtered, incremental titration, mg/L
00418 Alkalinity, water, filtered, fixed endpoint, mg/L
29802 Alkalinity, water, filtered, Gran titration, mg/L
00419 ANC, water, unfiltered, incremental titration
00410 ANC, water, unfiltered, fixed endpoint, mg/L
29813 ANC, water, unfiltered, Gran titration, mg/L
29804 Bicarbonate, water, filtered, fixed endpoint, mg/L
63786 Bicarbonate, water, filtered, Gran, mg/L
00453 Bicarbonate, water, filtered, incremental, mg/L
00440 Bicarbonate, water, unfiltered, fixed endpoint, mg/L
00450 Bicarbonate, water, unfiltered, incremental, mg/L
29807 Carbonate, water, filtered, fixed endpoint, mg/L
63788 Carbonate, water, filtered, Gran, mg/L
00452 Carbonate, water, filtered, incremental, mg/L
00445 Carbonate, water, unfiltered, fixed endpoint, mg/L
00447 Carbonate, water, unfiltered, incremental, mg/L
29810 Hydroxide, water, filtered, fixed endpoint, mg/L
71834 Hydroxide, water, filtered, incremental, mg/L
71830 Hydroxide, water, unfiltered, fixed endpoint, mg/L
71832Hydroxide, water, unfiltered, incremental, mg/L

GWSI—Water Level Method

A	Airline	Airline measurement
B	Recorder	Analog or graphic recorder
C	Calib. airline	Calibrated airline measurement
E	Estimated	Estimated
F	Transducer	Transducer
G	Pressure-gage	Pressure-gage measurement
H	Calib. Pres. Gage	Calibrated pressure-gage measurement
L	Geophysical log	Interpreted from geophysical logs
M	Manometer	Manometer measurement
N	Nonrec. Gage	Nonrecording gage
R	Reported	Reported, method not known
S	Steel tape	Steel-tape measurement
T	Electric tape	Electric-tape measurement
V	Calib. Elec. Tape	Calibrated electric-tape measurement
Z	Other	Other

GW form ver. 6.0

Appendix B-1. USGS Ground-water quality notes (GWQN) form.—Continued

U.S. GEOLOGICAL SURVEY – NATIONAL WATER QUALITY LABORATORY
ANALYTICAL SERVICES REQUEST

THIS SECTION MANDATORY FOR SAMPLE LOGIN

NWIS RECORD NUMBER / SAMPLE TRACKING ID	User Code	Project Account	LAB USE ONLY / NWQL LABORATORY ID

STATION ID	2 0 Begin Date (YYYYMMDD)	Begin Time	Medium Code	Sample Type

District Contact Phone Number	End Date (YYYYMMDD)	End Time	**District Contact Email**

SITE / SAMPLE / SPECIAL PROJECT INFORMATION (Optional)

State	County	Geologic Unit Code	Analysis Status*	Analysis Source*	Hydrologic Condition*	Hydrologic Event*	Chain of Custody	Sample Set

NWQL Proposal Number	NWQL Contact Name	NWQL Contact Email	Program/Project

Station Name: ______ Field ID: ______

Comments to NWQL: ______

Hazard (please explain): ______

ANALYTICAL WORK REQUESTS: SCHEDULES AND LAB CODES (CIRCLE A=add D=delete)

SCHED 1: ____ SCHED 2: ____ SCHED 3: ____ SCHED 4: ____ SCHED 5: ____ SCHED 6: ____

Lab Code: ____ A D	Lab Code: ____ A D	Lab Code: ____ A D	Lab Code: ____ A D	Lab Code: ____ A D
Lab Code: ____ A D	Lab Code: ____ A D	Lab Code: ____ A D	Lab Code: ____ A D	Lab Code: ____ A D
Lab Code: ____ A D	Lab Code: ____ A D	Lab Code: ____ A D	Lab Code: ____ A D	Lab Code: ____ A D

SHIPPING INFORMATION (Please fill in number of containers sent)

___ ALF	___ COD	___ FA	___ FCN	___ IQE	___ IRM	___ RA	___ RU	___ SUR	___ TPCN
___ BGC	___ CRB	___ FAM	___ FU	___ IQL	___ MBAS	___ RAM	___ RUR	___ SUSO	___ UAS
___ C18	___ CU	___ FAR	___ FUS	___ IQM	___ OAG	___ RAR	___ RURCT	___ TBI	___ WCA
___ CC	___ CUR	___ FCA	___ GCC	___ IRE	___ PHE	___ RCB	___ RURCV	___ TBY	___ ___
___ CHY	___ DOC	___ FCC	___ GCV	___ IRL	___ PIC	___ RCN	___ RUS	___ TOC	___ ___

NWQL Login Comments: ______

Collected by: ______ Phone No. ______ Date Shipped: ______

FIELD VALUES

Lab/P Code	**Value**	**Remark**	**Lab/P Code**	**Value**	**Remark**	**Lab/P Code**	**Value**	**Remark**
21/00095 Specific Conductance uS/cm @ 25 deg C			51/00400 pH Standard Units			2/39086 Alkalinity – IT mg/L as CaCO3		
/			/			/		

Field Comments: ______

*MANDATORY FOR NWIS

Form 9-3094 (August 2000)

Appendix B-2. USGS Analytical services request (ASR) form.

INSTRUCTIONS FOR COMPLETING ANALYTICAL SERVICES REQUEST FORM

SAMPLE IDENTIFICATION *(Mandatory)*

NWIS Record No.	-	Record number of sample assigned by NWIS database (District)
User Code	-	Enter District user code (indicates which office sample data are to be directed)
Project Acct	-	Enter 9 character account number
NWQL Laboratory ID	-	Leave blank (for Laboratory use only)
Station ID	-	Enter downstream order number, 15 digit latitude, longitude and sequence number or unique sample identifier
Begin Date (YYYYMMDD)	-	Enter 4 digit number for year, 2 digit number for month, 2 digit number for day sample collection started
Begin Time	-	Enter 4 digit military time sample collection started
Medium Code	-	Enter sample medium code (see attached table)
Sample Type	-	Enter sample type code (see attached table)
District Contact Phone Number	-	Enter complete phone number for District contact for sample questions or problems
End Date (YYYYMMDD)	-	Enter 4 digit number for year, 2 digit number for month, 2 digit number for day sample collection ended
End Time	-	Enter 4 digit military time sample collection ended
District Contact Email	-	Enter complete email address for District contact for sample questions or problems

SITE / SAMPLE / SPECIAL PROJECT INFORMATION (Optional)

State	-	Enter 2 digit FIPS code for State in which station is located
County	-	Enter 3 digit FIPS code for county in which station is located
Geologic Unit Code	-	Enter geologic unit code for ground-water sample (multiple aquifer identification)
*Analysis Status	-	Enter analysis status code (see attached table)
*Analysis Source	-	Enter analysis source code (see attached table)
*Hydrologic Condition	-	Enter hydrologic condition code (see attached table)
*Hydrologic Event	-	Enter hydrologic event code (see attached table)
Chain of Custody	-	Enter Y if sample is chain of custody
Sample Set	-	Enter identifier for sample set, and place on all bottles and associated log form, for example: "A", "BB" (max. 2)
NWQL Proposal Number -	-	Denotes non-routine or custom work assigned by NWQL in negotiated proposal
NWQL Contact Name	-	Enter name of NWQL person to be contacted when sample arrives at Lab
NWQL Contact Email	-	Enter email of NWQL person to be contacted when sample arrives at Lab
Program/Project	-	For example: NAWQA, NASQAN, NPDES, DW - if applicable
Station Name	-	Enter local station name
Field ID	-	Enter identification assigned by District
Comments to NWQL	-	Enter information about sample that NWQL should be aware of (high concentration, etc.)
		Note: Samples collected for analysis by Geologic Division **MUST** have the latitude/longitude provided for login
Hazard	-	Describe any known hazard associated with sample (chemical, biological, radiological, etc.)

ANALYTICAL WORK REQUESTS: SCHEDULES AND LAB CODES

Schedule	-	Enter schedule number(s) for the desired analyses.
Lab Code	-	Enter lab code for analyses to be added or deleted. Circle "A" for addition or "D" for deletion. Maximum 15.

SHIPPING INFORMATION (Please fill in number of sample types sent)

NWQL Login Comments	-	NWQL login personnel comments.
Collected by:	-	Enter name of individual that collected/shipped samples
Phone No.	-	Enter phone number of individual that collected/shipped samples
Date Shipped	-	Enter date samples packed/shipped to NWQL.

FIELD VALUES

Lab/P Code/Value/Remark	-	Enter values and remarks for sc, pH, alk, if needed, enter P code, value, remark for other field values
Field Comments	-	For field use only. Will not be used by NWQL.

*Mandatory for storage in NWIS

Appendix B-2. USGS Analytical services request (ASR) form.—Continued

Sample Medium Code	Description
A	Artificial
B	Solids (street sweepings, etc.)
C	Animal tissue
D	Plant tissue
E	Core material
F	Interstitial water
G	Soil
H	Bottom material
J	Sludge
K	Soil moisture
L-P	TAXONOMIC DATA
	L Phytoplanktonic species composition and enumeration
	M Phytoplanktonic species composition
	N Periphytic species composition
	O Benthic invertebrates species composition and enumeration
	P Periphytic diatoms species composition and enumeration
Q	Quality-assurance sample - Artificial
R	Quality-assurance sample - Surface water
S	Quality-assurance sample - Ground water
T	Quality-assurance sample - Wet deposition
U	Quality-assurance sample - Bulk deposition
V	Quality-assurance sample - Suspended sediment
W	Quality-assurance sample - Bottom material
X	Quality-assurance sample - Animal tissue
Y	Quality-assurance sample - Plant tissue
Z	Quality-assurance sample - Interstitial water
1	Suspended sediment
2	Leachate
3	Dry deposition
4	Landfill effluent
5	Elutriation
6	Ground water
7	Wet deposition
8	Bulk deposition
9	Surface water
0	Not determined
$	Treated water supply
%	Effluent
*	Air
&	Soil gas
{	QC sample for treated water supply
}	QC sample for effluent
[	QC sample for air
]	QC sample for soil gas

Sample Type Code	Description
A	Not determined
B	Other QA
H	Composite (time)
1	Spike
2	Blank
3	Reference
4	Blind
5	Duplicate
6	Reference material
7	Replicate
8	Spike Solution
9	Regular

*Analysis Status Code	Description
A	Not determined
H	Initial entry
1	Retrieved, in review
3	Data in temporary hold status
7	Reviewed, approved for transfer to EPA STORET
9	Proprietary data (Regional Hydrologist approval require

*Analysis Source Code	Description
A	Not determined
B	Non-USGS field
C	Non-USGS lab only
D	Non-USGS lab and field
F	USGS field and non-USGS field
G	USGS field and non-USGS lab
H	USGS field and non-USGS lab and field
1	USGS lab and non-USGS field
2	USGS lab and non-USGS lab
3	USGS lab and non-USGS lab and field
4	USGS lab and field and non-USGS field
5	USGS lab and field and non-USGS lab
6	USGS lab and field and non-USGS lab and field
7	USGS field only
8	USGS lab only
9	USGS lab and field

*Hydrologic Condition Code	Description
A	Not determined
4	Stable, low stage
5	Falling stage
6	Stable, high stage
7	Peak stage
8	Rising stage
9	Stable, normal stage
X	Not Applicable

Appendix B-2. USGS Analytical services request (ASR) form.—Continued

CODES USED IN WATER-QUALITY PROCESSING SYSTEM (Continued)

*Hydrologic Event Code	Description
A	Spring breakup
B	Under ice cover
C	Glacial lake outbreak
D	Mudflow
E	Tidal action
F	Drainage basin affected by fire
H	Dam break
J	Storm
K	Backwater
1	Drought
2	Spill
3	Regulated flow
4	Snowmelt
5	Earthquake
6	Hurricane
7	Flood
8	Volcanic action
9	Routine sample
X	Not applicable

Remark Code	Description
Blank	Not Remarked
E	Estimated Value
<	Actual value is known to be less than value shown
>	Actual value is known to be greater than value shown
M	Presence of material verified but not quantified
N	Presumptive evidence of presence of material
U	Material specifically analyzed for but not detected
A	Average value
V	Value affected by contamination - OWQ 97.8
S	Most probable value

VALUES FOR PARAMETER CODE 82398
(Sampling Method)

10	Equal Width Increment (EWI)
20	Equal Discharge Increment (EDI)
25	Timed sampling interval
30	Single vertical
40	Multiple verticals
50	Point sample
55	Composite-multiple point samples
60	Weighted bottle
70	Grab sample (dip)
80	Discharge integrated, equal transit rate (ETR)
90	Discharge integrated, centroid
100	Van Dorn sampler
110	Sewage sampler
120	Velocity integrated
200	Zooplankton-net
210	Benthic invertebrate-mechanical grab
220	Benthic invertebrate-mechanical dredge
230	Benthic invertebrate-artificial substrate
240	Benthic invertebrate-natural substrate
250	Benthic invertebrate-net
260	Phytoplankton-net
270	Phytoplankton-water bottle
280	Periphyton-natural substrate
290	Periphyton-artificial substrate
900	Suspended sediment; Pumping, stream sample using a pumping machine
910	Suspended sediment; Single-stage, nozzle at fixed stage, passively filling
920	Suspended sediment; Box single vertical, depth-integrated, attached to structure
930	Suspended sediment; Partial depth, depth integrated, part of single vertical
940	Suspended sediment; Partial width, depth/width integrated, part of cross-section
1000	(Bedload), Single equal width increment (SEWI)
1010	(Bedload), Multiple equal width increment (MEWI)
1020	(Bedload), Unequal width increment (UWI)
4010	Thief sample
4020	Open-top bailer
4025	Double-valve bailer
4030	Suction pump
4031	Suction lift centrifugal pump
4032	Suction lift jet pump
4033	Suction lift peristaltic pump
4040	Submersible pump
4041	Submersible bladder pump
4042	Submersible gas reciprocating pump
4043	Submersible gas lift pump
4044	Submersible jet pump
4045	Submersible multiple impeller (turbine) pump
4046	Submersible helical rotor pump
4047	Submersible gear pump
4048	Submersible gas-displacement pump
4050	Squeeze pump
4060	Gas reciprocating pump
4070	Gas lift
4080	Peristaltic pump
4090	Jet pump
4100	Flowing well
4110	Resin trap collector
5010	Sediment core
8010	Other
8020	Syringe sample
8030	Grab sample at water-supply tap

Appendix B-2. USGS Analytical services request (ASR) form.—Continued

CODES USED IN WATER-QUALITY PROCESSING SYSTEM (Continued)

*Hydrologic Event Code	Description
A	Spring breakup
B	Under ice cover
C	Glacial lake outbreak
D	Mudflow
E	Tidal action
F	Drainage basin affected by fire
H	Dam break
J	Storm
K	Backwater
1	Drought
2	Spill
3	Regulated flow
4	Snowmelt
5	Earthquake
6	Hurricane
7	Flood
8	Volcanic action
9	Routine sample
X	Not applicable

Remark Code	Description
Blank	Not Remarked
E	Estimated Value
<	Actual value is known to be less than value shown
>	Actual value is known to be greater than value shown
M	Presence of material verified but not quantified
N	Presumptive evidence of presence of material
U	Material specifically analyzed for but not detected
A	Average value
V	Value affected by contamination - OWQ 97.8
S	Most probable value

VALUES FOR PARAMETER CODE 82398
(Sampling Method)

10	Equal Width Increment (EWI)
20	Equal Discharge Increment (EDI)
25	Timed sampling interval
30	Single vertical
40	Multiple verticals
50	Point sample
55	Composite-multiple point samples
60	Weighted bottle
70	Grab sample (dip)
80	Discharge integrated, equal transit rate (ETR)
90	Discharge integrated, centroid
100	Van Dorn sampler
110	Sewage sampler
120	Velocity integrated
200	Zooplankton-net
210	Benthic invertebrate-mechanical grab
220	Benthic invertebrate-mechanical dredge
230	Benthic invertebrate-artificial substrate
240	Benthic invertebrate-natural substrate
250	Benthic invertebrate-net
260	Phytoplankton-net
270	Phytoplankton-water bottle
280	Periphyton-natural substrate
290	Periphyton-artificial substrate
900	Suspended sediment; Pumping, stream sample using a pumping machine
910	Suspended sediment; Single-stage, nozzle at fixed stage, passively filling
920	Suspended sediment; Box single vertical, depth-integrated, attached to structure
930	Suspended sediment; Partial depth, depth integrated, part of single vertical
940	Suspended sediment; Partial width, depth/width integrated, part of cross-section
1000	(Bedload), Single equal width increment (SEWI)
1010	(Bedload), Multiple equal width increment (MEWI)
1020	(Bedload), Unequal width increment (UWI)
4010	Thief sample
4020	Open-top bailer
4025	Double-valve bailer
4030	Suction pump
4031	Suction lift centrifugal pump
4032	Suction lift jet pump
4033	Suction lift peristaltic pump
4040	Submersible pump
4041	Submersible bladder pump
4042	Submersible gas reciprocating pump
4043	Submersible gas lift pump
4044	Submersible jet pump
4045	Submersible multiple impeller (turbine) pump
4046	Submersible helical rotor pump
4047	Submersible gear pump
4048	Submersible gas-displacement pump
4050	Squeeze pump
4060	Gas reciprocating pump
4070	Gas lift
4080	Peristaltic pump
4090	Jet pump
4100	Flowing well
4110	Resin trap collector
5010	Sediment core
8010	Other
8020	Syringe sample
8030	Grab sample at water-supply tap

Appendix B-2. USGS Analytical services request (ASR) form.—Continued

NWQL CHAIN OF CUSTODY RECORD

US Geological Survey, WRD, phone Contact:_________________ Ext: ______

NOTE: USE BLACK INK ONLY TO FILL IN THIS FORM	Analytical Schedules:
Project name:	
Sample Identification Number:	
Sampler's Name:	

Sample number (Field ID)	Date sampled (DDMMYY)	Time sampled (HHMM)	Lab ID (lab use only)	Sample matrix, (W, water; S, soil)	Number of containers	ASR Form Enclosed

CHAIN-OF-CUSTODY RECORD			
Relinquished by (signature)	Date (DDMMYY)	Time (HHMM)	Received by (signature)
Additional comments:			

SHIPPING DETAILS	
Seal number:	Delivered to shipper by:
Method of shipment:	Airbill number:
LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Lab:	Cooler seal intact upon receipt Yes____ No____ Conditions of contents: Contents temp. (^{o}C) on delivery:
Received for laboratory by: Carrier Sign: NWQL Sign Date: Time:	Laboratory Project Number:

Appendix B-3. NWQL Chain-of-custody (COC) record.

Example STL Chain-of-Custody Form

Chain of Custody Record

SEVERN TRENT SERVICES

Severn Trent Laboratories, Inc.

STL-4124 (0700)

Client	Project Manager	Date	Chain of Custody Number 016206
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page ____ of ____
City / State / Zip Code	Site Contact / Lab Contact	Analysis (Attach list if more space is needed)	
Project Name and Location (State)	Carrier/Waybill Number		Special Instructions/ Conditions of Receipt
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Matrix: Aqueous	Matrix: Sed.	Matrix: Soil	Matrix:	Containers & Preservatives: Unpres.	H_2SO_4	HNO_3	HCl	$NaOH$	ZnAc/ NaOH	Analysis	Special Instructions/ Conditions of Receipt

Possible Hazard Identification

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal

☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 3 months)

Turn Around Time Required

☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other______

QC Requirements (Specify)

1. Relinquished By	Date	Time	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

Appendix B-4. STL Chain-of-custody (COC) form.

FIGURE 8.5-2

Example STL Condition Upon Receipt Anomaly Report (CUR)

Client: ______________________ Date/Time: ______________________

Lot No: ______________________ Initiated by: ______________________

Affected Samples COC#____________

Client ID	Lab ID	Analyses Requested

CONDITION/ANOMALY/VARIANCE (CHECK ALL THAT APPLY):

❑COOLERS
- ❑Not Received, No Chain of Custody (COC)
- ❑Not Received but COC(s) Available
- ❑Leaking
- ❑Other: ____________

❑ TEMPERATURE (greater than 6° C)
- ❑Cooler Temp____________
- ❑Temperature Blank ____________

❑CONTAINERS
- ❑Leaking
- ❑Broken
- ❑Extra
- ❑Without Labels
- ❑VOA Vials with Headspace ________mm
- ❑Other: ____________

❑CUSTODY SEALS (COOLER(S)/CONTAINER(S)
- ❑None
- ❑ Not Intact
- ❑Other: ____________

❑CHAIN OF CUSTODY (COCs)
- ❑Not relinquished by Client: No date/time Relinq.
- ❑ Incomplete Information
- ❑Other: ____________

❑ CONTAINER LABELS
- ❑Not the same ID/info as in COC
- ❑ Incomplete
- ❑ID COLLECTION ❑Time ❑Date ❑PRESERVATIVE
- ❑ Markings/Info smeared or illegible
- ❑Torn
- ❑Other: ____________

❑ SAMPLES
- ❑Samples NOT RECEIVED but listed on COC ------ ❑will be noted on COC ❑ Client to send samples with new COC
- ❑Samples received but NOT LISTED on COC
- ❑Logged based on Label Information
- ❑Logged based on info from other samples on COC
- ❑ Logged according to Work Plan
- ❑Logged on HOLD UNTIL FURTHER NOTICE
- ❑ Other: ____________
- ❑ Mislabeled as to tests, preservatives, etc.
- ❑Holding time expired
- ❑ Improper container used
- ❑Not preserved / Improper preservative used
- ❑ Improper pH ________ ❑ Lab to preserve sample
- ❑ Insufficient quantities for analysis

Comments: ____

Corrective Action:
- ❑ Client Informed: verbally on: ________By: ________: In writing on: ________ By: ________
- ❑ Sample(s) processed "as is". ______________________
- ❑ Sample(s) on hold until: ____________ If released, notify: ____________

Sample Control Supervisor Review: ______________________ Date: ____________

Project Management Review: ______________________ Date: ____________

SIGNED ORIGINAL MUST BE RETAINED IN THE PROJECT FILE

Appendix B-5. STL Condition upon receipt (CUR) anomaly report.

Prepared by the USGS Nebraska Water Science Center:
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